2006 Building Code Overview Training Courses

HVAC - House - 2006

Participant's Manual

Building and Development Branch
Ministry of Municipal Affairs & Housing

Ontario

Ontario

Ministry of Municipal Affairs and Housing

HVAC~HOUSE COURSE 2006

" This course material may assist you in preparing for writing the Ministry exams however it is strongly suggested that you also refer to the Qualification and Registration pages on the Building Code website (www.ontario.ca/buildingcode) for detailed examination syllabi, as well as reading and reviewing the Code. "

HVAC – HOUSE
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Ontario

Ministry of Municipal Affairs and Housing

HVAC-HOUSE

PARTICIPANT'S MODULE #1

The OBC and HVAC-House – Scope and Definitions

May 2008

INTRODUCTION

This module will establish the scope of the course and introduce the concepts of Heating Ventilating and Air-Conditioning (HVAC) and review fundamental definitions and navigation within the Ontario Building Code (OBC).

OBJECTIVES

Upon completion of this module, participants will:

- Strengthen their OBC navigation skills;
- Distinguish scope of course contents;
- Describe and apply definitions and terms;
- Apply concepts of *building area* and *occupancy*;
- Understand the concept of "applicable edition" of reference standards.

COURSE OBJECTIVES

The objective of this course is to help you understand the requirements of the Ontario Building Code (OBC) applicable to the area of HVAC-House (primarily dwelling units). This includes requirements contained in Parts 1, 6, 9, 11 and 12.

Every effort has been made to cover major topics of the Building Services (HVAC House) content of the code as much as possible in this course material. However, participants must review the Building Code and become familiar with all requirements related to subject matter.

Learning Outcomes

The course has been designed to introduce or increase (where applicable) a practitioner's knowledge of the OBC and to hone skills in terms of their ability to **FIND** (search the Code and identify non-familiar Code provisions), **UNDERSTAND** (to comprehend the language, structure and intent of a Code provision), and **APPLY** the Code provision(s) using case examples, situations and scenarios.

The Ministry of Municipal Affairs also provides more comprehensive courses for practitioners wishing to obtain more detailed training in the use and application of the OBC and a number of its referenced standards. For information on the available courses, refer to the following website under the heading "Training":

http://www.ontario.ca/buildingcode

COURSE FORMAT

This course is organized in eight modules and is intended for those who desire to become more proficient in applying the provisions of the requirements applicable to HVAC-House.

PURPOSE OF THE EXERCISES

Every module contains a number of exercises. Each exercise is designed to help you to identify, understand and apply the requirements of the OBC and their effect on the design and construction of HVAC systems for dwelling units. The exercises are fill-in-the-blanks.

You will also be required to indicate the OBC reference for your answer. Pay attention to the detail of the reference. Any time a Code reference is asked for, it will be identified by "OBC Reference _____"

As you go along, you are encouraged to modify and enhance your copy of the OBC.

When reference is made to specific provisions of the Building Code at the beginning of an exercise, you may find it useful to review those references **before** attempting the exercise.

COURSE RESOURCES

Your participation, with support from the Facilitator, the OBC, and the experiences, ideas, and comments of your fellow students are the primary resources of this course. The objective of the course integrates your education, prior training and on-the-job experience, as well as those of your peers. It is important that you participate. For each question or task that is assigned to your table-group, you will select a

spokesperson who will print the agreed upon answer on the flipchart. When asked by the Facilitator, the spokesperson will explain the group's answer, which forms the basis for class discussion.

The course only requires the latest edition of the 2006 Ontario Building Code, which is available for purchase through:

Service Ontario
Publications Ontario
www.publications.gov.on.ca
416-325-5300

THE OBJECTIVE-BASED CODE

The 2006 Ontario Building Code is published in an "objective-based" format. The objective-based format adds to the technical requirements by identifying the underlying objectives and sub-objectives of those requirements. Each technical requirement that is an acceptable solution in Division B is linked to one or more objectives, as well as functional statements.

The objective-based format is intended to assist Code users in understanding technical requirements, why they exist and what they are intended to achieve. The objective-based code establishes a framework for evaluating "alternative solutions" against the performance achieved by "acceptable solutions" set out in the Code.

This course is updated to reflect technical changes to the 2006 Ontario Building Code. **Training related to the objective-based format, and how to deal with alternative solutions is part of another course.** This course addresses only "acceptable solutions".

A few key points about the objective-based code are below.

The organization of the 2006 Code is:

Division A **Compliance, Objectives and Functional Statements**

The new objectives and functional statements are in Division

A. Definitions and the application of the Parts of the Code are here.

Division B Acceptable Solutions

This is where the technical requirements of the 1997 Code are located (with technical changes for the 2006 edition), with a similar Part structure.

Division C Administrative Provisions

This Division deals with permits, inspections and qualifications.

Remember that the full reference for Part 6 (Heating, Ventilating and Air-Conditioning) is "Division B, Part 6". Always specify the appropriate Division if there is any chance of confusion. Where the Division is not referenced within this course, it is Division B.

When "OBC" is used in this course it refers to the Ontario Building Code, NOT the Objective Based Code.

A GUIDE TO THE USE OF THE OBC

The Ontario Building Code is a regulation made under the Building Code Act. This edition is prepared for purposes of convenience only and contains additional explanatory material. For accurate reference, recourse should be had to the Official Volumes.

The Ontario Building Code is base, in large measure, on the National Building Code of Canada (NBC).

The Code is essentially a set of minimum requirements respecting the safety of buildings with reference objectives such as public health, fire protection and structural sufficiency. It is not intended to be a textbook on building design, advice on which should be sought from professional sources. Its primary purpose is the promotion of public safety through the application of appropriate uniform building standards.

The decimal numbering system of the previous Code is maintained within Divisions A, B and C of the 2006 Code. The first number indicates the Part of the Code, the second, the Section in the Part, the third, the Subsection and the fourth, the Article in the Subsection. An Article may be further broken down into Sentences (indicated by numbers in brackets), and the Sentence further divided into Clauses and Subclauses.

These are illustrated as follows:

B	Division
6	Part
6.2.	Section
6.2.12.	Subsection
6.2.12.3.	Article
6.2.12.3.(1)	Sentence
6.2.12.3.(1)(d)	Clause
6.2.12.3.(1)(d)(i)	Subclause

BASIC RULES FROM THE OBC

Defined Words, Terms And Phrases

Words, terms and phrases with special meanings are defined in Division A, Article 1.4.1.2. of the OBC, and are shown within the body of the OBC in *italics*. The definition always applies unless the word, term or phrase has a special purpose definition listed elsewhere.

Non-Defined Words, Terms And Phrases

Consult Division A, Article 1.4.1.1. of the OBC. It provides direction for dealing with non-defined terms.

Note any questions, comment or concern in the space provided.

BASIC RULES FOR READING THE OBC – SCOPE AND APPLICATION OF OBC REQUIREMENTS

Individual requirements within the OBC do not apply to every *building*. Guidance in the application of each of the 12 Parts of Division B is found in Division A, Subsection 1.1.2.

For this course, it is important to know Parts 1 and 12 of Division B apply to all buildings, and that Part 9 will apply to the majority of houses since houses are generally three storeys or less in building height, and have a building area not exceeding 600 m^2.

Part 11 will apply to construction in an existing building that is at least five years old.

Note that although Division A, Article 1.1.2.2. states that Part 6 applies to buildings over 3 storeys and/or 600 m^2 in building area, some provisions of Part 6 may still be applicable to a typical house when they are referenced through another applicable Part, such as Part 9.

Dealing With 'And'

The word '**and**' found at the end of the second last Clause of a Sentence with multiple Clauses means that the requirements of **every** Clause apply to the Sentence.

For example, Sentence 9.33.4.2.(2) reads:

> Where a fuel-burning *appliance* is installed in a *service room* that is not in a *suite* of *residential occupancy*, a carbon monoxide detector shall be installed,
>
> (a) adjacent to each sleeping area in every suite of residential occupancy that is adjacent to the service room, and
>
> (b) in the service room.

Dealing With 'Or'

The word '**or**' found at the end of the second last Clause of a Sentence with multiple Clauses means that the requirement of the Sentence is satisfied by **any** Clause as applied individually.

For example, Sentence 6.2.9.2.(7) reads:

> No *flame-spread rating* or smoke developed classification limitations are required where *combustible* insulation and coverings are used on piping when such piping is,
>
> (a) located within a concealed space in a wall,
>
> (b) located in a floor slab, **or**
>
> (c) encased in a noncombustible raceway or conduit.

Some Sentences have both "and" and "or" in the clauses and subclauses. When reading these provisions first check the clause provisions – these should be linked by an "and" or "or" at the second-last clause. Then check the sub-clause provisions to be clear on how they are linked. It may help to remember that "and" means all the provisions apply, and the "or" means that there is a choice of any one. For an example of this, try analyzing Sentence 9.32.3.1.(2).

RULES OF THE OBC

The OBC is structured into a number of Rules that apply without exception.

For example, Sentence 9.33.3.12.(8) states: Air intake openings shall incorporate screens or grilles to protect against the entry of animals and insects.

General Rules Of The OBC And Exceptions

At other times, the user of the OBC has to consider a general rule and exceptions that may be applicable. Consider the requirements for materials in air duct systems in Article 6.2.3.2.:

(1) Except as provided in Sentences (2) to (4) and in Article 3.6.4.3., all ducts, duct connectors, associated fittings and *plenums* used in air duct systems shall be constructed of steel, aluminum alloy, copper, clay, asbestos-cement or similar *noncombustible* material.

(2) Ducts, associated fittings and plenums are permitted to contain *combustible* material provided they, (a)...

(3) Ducts sealants shall have a *flame-spread rating* of not more than 25 and a smoke developed classification of not more than 50.

(4) Duct connectors that contain *combustible* materials and that are used between ducts and air outlet units shall, (a)...

When the OBC spells out a general rule and exceptions thereto, conformity with the OBC is obtained by complying with EITHER the general rule OR the exception and its conditions (if any).

TABLES, TEXT AND FOOTNOTES

Whenever you are called upon to use a Table in the OBC, you have to consider the text associated with the Table and the footnotes.

For example, Table 9.32.3.5. forms part of Sentence 9.32.3.5.(4). Note (1) to Table 9.32.3.5. tells us that where flexible duct is used, the duct diameter shall be increased by 25 mm (1in).

SUPPLEMENTARY STANDARDS AND REFERENCED DOCUMENTS

The Supplementary Standards, published as Volume 2 of the 2006 Building Code Compendium form an **integral part of the 2006 Ontario Building Code.**

The Supplementary Standards are referenced from within the OBC. For example, Sentence 9.33.3.2.(1) states that the outdoor conditions to be used in designing HVAC systems shall be the appropriate values for the Municipality as set out in Supplementary Standard SB-1.

APPENDICES

The Appendices to the Ontario Building Code, published in Volume 2, have been prepared for convenience only. This material contains explanations that do **not** form part of the OBC and are **not** intended to limit the ways by which compliance with OBC requirements can be achieved.

COMMENTS ON THE COURSE

In preparation to attend this course, you are asked to complete as many of the exercises as you can. During the delivery of the course, you are asked to obey the STOP signs, the Facilitator will provide guidance to keep the course moving. Bring your questions and comments to the course and participate in all the discussions.

Your evaluation of the course and comments on its contents will be collected during the session. Your input is important, it enables the Building and Development Branch of the Ministry of Municipal Affairs to keep the course current and to meet your needs. In preparation, you are asked to note your comments on plain paper. They will be collected at the end of the course. You will also be asked to evaluate the Facilitator and the facilities where the course is being held, at the end of the course.

Unlike the course, for the qualification examination, you will not be asked to provide references to support your answers. Nevertheless, you are strongly encouraged to find the supporting part of the OBC. Remember, you need to find a requirement before you can understand and apply it.

SCOPE OF HVAC IN THE OBC

Division B Part 6 Heating, Ventilating and Air-Conditioning, applies to all *buildings* occupying an area greater than ten square meters and used for;

- Group A, *assembly occupancies*,
- Group B, *care or detention occupancies*, or
- Group F, Division 1, *high hazard industrial occupancies*

Division B Part 6 also applies to all *buildings* occupying an area exceeding 600 m^2 in *building area* or exceeding 3 *storeys* in *building height* used for *major occupancies* classified as;

- Group C, *residential occupancies*,
- Group D, *business and personal services occupancies*,
- Group E, *mercantile occupancies*, or
- Group F, Division 2 and 3, *medium* and *low hazard industrial occupancies*.

The exceptions to the above include

- *farm buildings* (see Division A Article 1.3.1.2., covered by National Farm Building Code)
- existing *buildings* (older than five years) by Division B Part 11
- designated structures as defined in Division A Article 1.3.1.1.

Division B Part 9 Housing and Small Buildings, applies to *buildings* occupying an area greater than ten square metres, of 3 *storeys* or less in *building height*, having a *building area* not exceeding 600 m^2, and used for

- Group C, *residential occupancies*,
- Group D, *business and personal services occupancies*,

- Group E, *mercantile occupancies*, or
- Group F, Division 2 and 3, *medium* and *low hazard industrial occupancies*.

The exceptions to the above include

- a manufactured *building* intended for *residential occupancy* that complies with standards and requirements recognized and described in Division B, Article 9.1.1.9.
- *farm buildings* (covered by National Farm Building Code)
- existing *buildings* (older than five years) by Part 11

HVAC – HOUSE: COURSE INTRODUCTION

This course covers the requirements of the OBC as applied to HVAC including the supporting infrastructure of

- heat transfer control,
- air leakage control,
- condensation control,

with a particular focus on requirements for

- heating, ventilating and air-conditioning systems that serve individual dwelling units within the scope of Part 9

Buildings containing the above systems are generally of *residential occupancy* and classified as OBC Part 9 *buildings*.

ENERGY EFFICIENCY

As per Division B, Article 12.2.1.1., the energy efficiency of all *buildings* is to be designed to good engineering practice as described in

- the ANSI/ASHRAE/IESNA 90.1, "Energy Standard for Buildings Except Lowrise Residential Buildings" and Supplementary Standard SB-10, or
- the CCBFC, "Model National Energy Code for Buildings" and Supplementary Standard SB-10.

The exceptions to the above include

- *farm buildings*, and
- areas of *buildings* intended primarily for manufacturing or commercial or industrial processing.

Houses are also exempted from the above requirements, however, they must meet one of 3 conditions according to Sentence 12.2.1.1.(3):

The energy efficiency of a building or part of a building of residential occupancy that is within the scope of Part 9 and is intended for occupancy on a continuing basis during the winter months shall,

(a) conform to the thermal insulation requirements of Subsection 12.3.2.,

(b) conform to the thermal design requirements of Subsection 12.3.3., or

(c) provide a rating of 80 or more when evaluated in accordance with NRCan, "EnerGuide for New Houses: Administrative and Technical Procedures".

As stated in the introduction, this course is focused on HVAC for *buildings* generally of *residential occupancy* and classified as Part 9 *buildings*. The energy efficiency requirements of Part 12 will also apply to the design of these buildings and will be discussed in this course.

EXISTING BUILDINGS AND BUILDING SYSTEMS

When an existing building is altered or renovated, the requirements for new design are not always applicable. The OBC sets out the application rules for construction in existing buildings. The following issues are addressed by Division B Part 11, and are discussed in Module 8 of this course.

- New and Existing Building Systems
- Material Alteration or Repair of a Building System
- New Building Systems and Extension of Existing Building Systems
- Extension of Buildings
- Portion of Extended Buildings

EXAMPLE QUESTION

Describe the search process for finding the OBC reference to CAN/ULC-S109, "Standard for Flame Tests of Flame-Resistant Fabrics and Films" with regard to *combustible* fabric vibration isolation connectors in air duct systems?

Answer: _____

_____

_____

OBC Reference _____

EXERCISE #1-1

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. Which one of the following buildings is required to be designed to conform to ANSI/ASHRAE/IESNA 90.1?
    a) A 600m^2 building area mushroom growing facility;
    b) A 50m^2 building area retail store;
    c) A 500m^2 building area luxury bungalow;
    d) A 50m^2 building area metal foundry.

OBC Reference _____

2. Which one of the following is NOT an allowed OBC Part 9 *occupancy*?
    a) *Mercantile occupancy;*
    b) *Care occupancy;*
    c) *Residential occupancy;*
    d) *Medium hazard industrial occupancy.*

OBC Reference _____

3. Which exact edition of the NRCan "Energuide for New Houses" is applicable if compliance with Clause 12.2.1.1.(3)(c) is selected?
    a) Current edition;
    b) First edition;
    c) 2004 edition;
    d) 2005 edition.

OBC Reference _____

4. Describe the search process for finding the OBC applicable edition of CAN/ULC- S112, "Standard Method of Fire Test of Fire-Damper Assemblies"?

Answer:

_____

_____

_____

OBC Reference _____

DEFINITIONS OF WORDS AND PHRASES

Lists of definitions of words and phrases are included in Division A, Part 1 of the OBC. Definitions of words and phrases used in the OBC that are not included in the list of definitions in the OBC have meanings which are commonly assigned to them in the various trades and professions to which the terminology applies (See Div A, 1.4.1.1.). Defined words or phrases used in the OBC are indicated by the use of italics and have the following meaning for the purposes of the OBC. The first half (A to L) of the list has been edited for terms most commonly found within the scope of this course.

Air barrier system means the assembly installed to provide a continuous barrier to the movement of air.

Air-conditioning is the process of treating air to control simultaneously its temperature, humidity, cleanliness, and distribution to meet the comfort requirements of the occupants of the conditioned space.

Appliance means a device to convert fuel into energy and includes all components, controls, wiring and piping required to be part of the device by the applicable standard referred to in this Code.

Architect means, for the purposes of the Act and this Code, the holder of a licence, a certificate of practice or a temporary licence under the *Architects Act*.

Attic or roof space means the space between the roof and the ceiling of the top *storey* or between a dwarf wall and a sloping roof.

Basement means a *storey* or *storeys* of a *building* located below the *first storey*.

Boiler means an *appliance* intended to supply hot water or steam for space heating, processing or power purposes.

Breeching means a *flue pipe* or chamber for receiving *flue* gases from 1 or more *flue* connections and for discharging these gases through a single *flue* connection.
Building area means the greatest horizontal area of a *building* above *grade* within the outside surface of exterior walls or within the outside surface of exterior walls and the centre line of *firewalls*.

Building Code website means the website at www.ontario.ca/buildingcode.

Building height means the number of *storeys* contained between the roof and the floor of the *first storey*.

Business and personal services occupancy means the *occupancy* or use of a *building* or part thereof for the transaction of business or the rendering or receiving of professional or personal services.

Chimney means a primarily vertical shaft enclosing at least 1 *flue* for conducting *flue* gases to the outdoors.

Chimney liner means a conduit containing a *chimney flue* used as a lining of a *masonry or concrete chimney*.

Combustible means that a material fails to meet the acceptance criteria of CAN4-S114, "Standard Method of Test for Determination of Non-Combustibility in Building Materials."

Combustible construction means that type of construction that does not meet the requirements for *noncombustible construction*.

Compliance alternative means a substitute for a requirement in another Part of Division B that is listed in Part 10 or 11 of Division B, and "C.A." has a corresponding meaning.

Conditioned space means any space within a *building* the temperature of which is controlled to limit variation in response to the exterior ambient temperature or interior differential temperatures by the provision, either directly or indirectly, of heating or cooling over substantial portions of the year.

Construction index means a level on a scale of 1 to 8 determined in accordance with Table 11.2.1.1.A. designating the expected *performance level* of the *building* structure with respect to the type of *construction* and fire protection of an existing *building*, and "C.I." has a corresponding meaning.

Designer means the person responsible for the design.

Dwelling unit means a *suite* operated as a housekeeping unit, used or intended to be used as a domicile by 1 or more persons and usually containing cooking, eating, living, sleeping and sanitary facilities.

Electric space heating means an electric energy source that provides more than 10% of the heating capacity provided for the *building* and includes:

(a) electric resistance unitary baseboard heating,

(b) electric resistance unitary cabinet heating,

(c) electric resistance ceiling cable or floor cable heating,

(d) electric resistance central furnace heating,

(e) electric hot water space heating, or

(f) air source heat pumps in combination with electric resistance backup heating.

Exhaust duct means a duct through which air is conveyed from a room or space to the outdoors.

Exterior cladding means those components of a *building* that are exposed to the outdoor environment and are intended to provide protection against wind, water or vapour.

Factory-built chimney means a *chimney* consisting entirely of factory-made parts, each designed to be assembled with the other without requiring fabrication on site.

Farm building means a *building*,

(a) that does not contain any area used for *residential occupancy*,

(b) that is associated with and located on land devoted to the practice of farming, and

(c) that is used essentially for the housing of equipment or livestock, or the production, storage or processing of agricultural and horticultural produce or feeds.

First storey means the *storey* with its floor closest to *grade* and having its ceiling more than 1.8 m above *grade*.

Flame-spread rating means an index or classification indicating the extent of spread-of-flame on the surface of a material or an assembly of materials as determined in a standard fire test as prescribed in this Code.

Floor area means the space on any *storey* of a *building* between exterior walls and required *firewalls* including the space occupied by interior walls and *partitions*, but not including *exits*, *vertical service spaces*, and their enclosing assemblies.

Flue means an enclosed passageway for conveying *flue* gases.

Flue collar means the portion of a fuel-fired *appliance* designed for the attachment of the *flue pipe* or *breeching*.

Flue pipe means the pipe connecting the *flue collar* of an *appliance* to a *chimney*.

Forced-air furnace means a *furnace* equipped with a fan that provides the primary means for the circulation of air.

Furnace means a *space-heating appliance* using warm air as the heating medium and usually having provision for the attachment of ducts.

Gas vent means that portion of a venting system designed to convey vent gases to the outdoors,

(a) from the *vent connector* of a gas-fired *appliance*, or

(b) directly from the *appliance* when a *vent connector* is not used.

Grade means the average level of proposed or finished ground adjoining a *building* at all exterior walls.

Heavy timber construction means that type of *combustible construction* in which a degree of fire safety is attained by placing limitations on the sizes of wood structural members and on thickness and composition of wood floors and roofs and by the avoidance of concealed spaces under floors and roofs.

Horizontal service space means a space such as an attic, duct, ceiling, roof or crawl space

(a) that is oriented essentially in a horizontal plane,

(b) that is concealed and generally inaccessible, and

(c) through which *building* service facilities such as pipes, ducts and wiring may pass.

Listed means equipment or materials included in a list published by a certification organization accredited by the Standards Council of Canada.

Live/work unit means a *dwelling unit* that contains a subsidiary *business and personal services occupancy* or a subsidiary *low hazard industrial occupancy*, has an area of not more than 150 m^2, and is used and operated by one or more persons of a single household.

Low hazard industrial occupancy (Group F, Division 3) means an *industrial occupancy* in which the *combustible* content is not more than 50 kg/m^2 or 1200 MJ/m^2 of *floor area*.

EXAMPLE QUESTION

Which one of the following components is included in the OBC definition of *building area*?

a) Total area within interior walls;
b) Sum of all horizontal area;
c) Horizontal area above grade;
d) Greatest area of a *building*.

OBC Reference _____

EXERCISE #1-2

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. Based of the OBC definition of *appliance*, which one of the following is NOT an *appliance*?
   a) Heating boiler;
   b) Dishwasher;
   c) Hot water tank;
   d) Furnace.

OBC Reference _____

2. Which of the following *occupancies* is NOT allowed under the OBC definition of a *live/work unit.*
    a) *Residential occupancy;*
    b) *Business and personal services occupancy;*
    c) *Low hazard industrial occupancy;*
    d) *Mercantile occupancy.*

OBC Reference _____

3. Based on the OBC definition of *electric space heating,* which one of the following heating methods is NOT *electric space heating*?
    a) Electric resistance infrared lamp;
    b) Electric resistance ceiling cable;
    c) Electric hot water boiler;
    d) Air source heat pump with electric resistance back-up heating.

OBC Reference _____

4. In the OBC definition of *heavy timber construction* which of the following assists in improving the degree of fire safety?
    a) *Combustible construction;*
    b) Maximizing size of wood structural members;
    c) Avoidance of concealed spaces;
    d) Composition of walls.

OBC Reference _____

DEFINITIONS OF WORDS AND PHRASES - Continued

The second half (M to Z) of the list of defined words and phrases has been edited for terms most commonly found within the scope of this course.

Major occupancy means the principal *occupancy* for which a *building* or part thereof is used or intended to be used, and is deemed to include the subsidiary *occupancies* which are an integral part of the principal *occupancy*.

Masonry or concrete chimney means a *chimney* of brick, stone, concrete or masonry units constructed on site.

Medium hazard industrial occupancy (Group F, Division 2) means an *industrial occupancy* in which the *combustible* content is more than 50 kg/m^2 or 1200 MJ/m^2 of *floor area* and not classified as *high hazard industrial occupancy*.

Mercantile occupancy means the *occupancy* or use of a *building* or part thereof for the displaying or selling of retail goods, wares or merchandise.

Noncombustible means that a material meets the acceptance criteria of CAN4-S114, "Standard Method of Test for Determination of Non-Combustibility in Building Materials".

Noncombustible construction means that type of construction in which a degree of fire safety is attained through the use of *noncombustible* materials for structural members and other building assemblies.

Occupancy means the use or intended use of a *building* or part thereof for the shelter or support of persons, animals or property.

Occupant load means the number of persons for which *building* or part thereof is designed.

Open air means the atmosphere outside a *building*.

Partition means an interior wall 1 *storey* or part-*storey* in height that is not *loadbearing*.

Party wall means a wall jointly owned and jointly used by 2 parties under easement agreement or by right in law, and erected at or upon a line separating 2 parcels of land each of which is, or is capable of being, a separate real-estate entity.

Plenum means a chamber forming part of an air duct system.

Professional engineer means, for the purposes of the Act and this Code, a person who holds a licence or a temporary licence under the *Professional Engineers Act*.

Range means a cooking *appliance* equipped with a cooking surface and one or more ovens.

Residential occupancy means the *occupancy* or use of a *building* or part thereof by persons for whom sleeping accommodation is provided but who are not harboured or detained to receive medical care or treatment or are not involuntarily detained.

Return duct means a duct for conveying air from a space being heated, ventilated or air-conditioned back to the heating, ventilating or *air-conditioning appliance*.

Self-service storage building means a *building* that is used to provide individual storage spaces to the public and that is open to the public only for those purposes.

Service room means a room provided in a *building* to contain equipment associated with *building* services.

Service space means space provided in a *building* to facilitate or conceal the installation of building service facilities such as chutes, ducts, pipes, shafts or wires.

Space heater means a *space-heating appliance* for heating the room or space within which it is located, without the use of ducts.

Space-heating appliance means an *appliance*,

(a) that is intended to supply heat directly to a room or space, such as a *space heater*, fireplace and *unit heater*, or

(b) that is intended to supply heat to rooms or spaces of a *building* through a heating system such as a central *furnace* or *boiler*.

Storey means that portion of a *building* which is situated between the top of any floor and the top of the floor next above it, and if there is no floor above it, that portion between the top of such floor and the ceiling above it.

Stove means an *appliance* intended for cooking and space heating.

Suite means a single room or series of rooms of complementary use, operated under a single tenancy, and includes,

(a) *dwelling units*,

(b) individual guest rooms in motels, hotels, boarding houses, rooming houses and dormitories, and

(c) individual stores and individual or complementary rooms for *business and personal services occupancies*.

Supply duct means a duct for conveying air from a heating, ventilating or *air-conditioning appliance* to a space to be heated, ventilated or air-conditioned.

Unit heater means a suspended *space heater* with an integral air circulating fan.

Vent connector as applying to heating or cooling systems means the part of a venting system that conducts the *flue* gases or vent gases from the *flue collar* of a gas *appliance* to the *chimney* or *gas vent*, and may include a draft control device.

Vertical service space means a shaft oriented essentially vertically that is provided in a *building* to facilitate the installation of building services including mechanical, electrical and plumbing installations and facilities such as elevators, refuse chutes and linen chutes.

Abbreviations

Abbreviations of proper names in the OBC are defined in Division B Article 1.3.2.1.. Examples of commonly used abbreviations are:

- ASHRAE American Society of Heating, Refrigeration and Air-Conditioning Engineers
- CAN National Standard of Canada designation (the number or name following the CAN designation represents the agency under whose auspices the standard is issued. CAN1 designates CGA, CAN2 designates CGSB, CAN3 designates CSA, and CAN4 designates ULC.)
- CSA Canadian Standards Association
- NFPA National Fire Protection Association
- ULC Underwriters' Laboratories of Canada

Symbols

Common symbols and abbreviations of common words are defined in Division A Table 1.4.2.1. of the OBC. Some examples include:

- °C degree(s) in Celsius
- HVAC Heating Ventilation and Air Conditioning

Referenced Documents

The OBC references numerous documents published by various agencies that have established standards of quality and safety such as CSA, NFPA, ULC, and many others. There are three important things to note about referenced documents: their applicable edition, the extent to which they apply, and what to do if there are conflicting requirements.

It is important to note that the OBC **applicable edition** of a document is as specifically declared in Division B Part 1 of the OBC and may not be the latest edition of the document available from the issuing agency.

It is also important to note the **extent to which a referenced document applies**, as stated in Division A, Sentence 1.5.1.1.(1):

The provisions of a referenced document in Divisions A and B apply only to the extent that the provisions relate to,

(a) *buildings*, and

(b) the *objectives and functional statements* attributed to the applicable *acceptable solutions* in Division B where the document is referenced.

To illustrate this, use the fictional example that a certain standard may be referenced for installation requirements of ducts. If the reference standard included provisions for the colour of such ducts, but the OBC did not have an objective or functional statement linked to duct installation that deals with colour, the colour requirements from the standard would not applicable.

If there are **conflicting requirements** between the Code and a referenced standard, Division A, Article 1.5.1.2. states that the Code shall govern.

EXAMPLE QUESTION

Based on the OBC definition, *noncombustible* construction means?

a) Construction using only concrete;
b) Conformance to CAN4-S115;
c) Use of *noncombustible* materials;
d) Use of treated lumber.

OBC Reference _____

EXERCISE #1-3

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple choice method.

1. Based on the OBC definition, *open air* means?
    e) Balcony *building* area;
    f) Ventilation from open windows;
    g) Atmosphere outside a *building*;
    h) Ventilation from openable skylights.

OBC Reference _____

2. Based on the OBC definition, what does a *service room* contain?
    a) *Personal services occupancy*;
    b) Electrical meters only;
    c) *Building* services equipment;
    d) Vehicle repair equipment.

OBC Reference _____

3. Based on the OBC definition, which of the following is a characteristic of a *partition*?
    a) Exterior wall;
    b) *Loadbearing*;
    c) Finished floor to ceiling;
    d) Not *loadbearing*.

OBC Reference _____

Ontario

Ministry of Municipal Affairs and Housing

HVAC-HOUSE

PARTICIPANT'S MODULE #2

HVAC Design and Installation – All Buildings

May 2008

INTRODUCTION

This module examines the foundations of good engineering practice and the wide variety of standards that form the basis of the OBC structure. Particular attention is paid to applicable editions of referenced standards, and the design, arrangement, and basic requirements for HVAC systems in all *buildings*.

OBJECTIVES

Upon completion of this module, participants will:

- Comprehend the concept of good engineering practice;
- Explain the application of design indoor temperatures;
- Reference outside design condition tables accurately;
- Recognize general standards for equipment installation;
- Know and understand the requirements for installation of equipment;
- Describe the requirements for ventilation (natural and mechanical) and control of air contaminants in all buildings.

GOOD ENGINEERING PRACTICE AND DESIGN

The OBC requires heating, ventilating and *air-conditioning* systems to be designed, constructed and installed to conform to good engineering practice appropriate to the circumstances as described in the ASHRAE Handbooks as follows:

- Fundamentals,
- Refrigeration,
- HVAC Applications,

HVAC Systems and Equipment and in various other publications including:

- CAN/CSA-F280-M, "Determining the Required Capacity of Residential Space Heating and Cooling Appliances", when used in conjunction with the outside winter design temperatures in Supplementary Standard SB-1,
- CAN/CSA-F326-M, "Residential Mechanical Ventilation Systems",
- NFPA Fire Codes,
- HRAI Digest,
- Hydronics Institute Manuals,
- SMACNA Manuals,
- the ACGIH Industrial Ventilation Manual, and
- Model National Energy Code for Buildings.

The standards cited and used by the OBC are not always the latest editions of the document. Always confirm the edition in use by the OBC by checking in Division B, Table 1.3.1.2.

Accommodation of Structural Movement

The design and installation of mechanical systems and equipment is required to accommodate the maximum relative structural movement provided for in the *construction* of the *building*. Relative structural movement can be caused by loads including wind, gravity, earthquake loads and building settlement

Design Indoor Air Temperatures

Buildings that are intended for use in the winter months on a continuing basis are required to be insulated and to be equipped with heating facilities that are capable of maintaining indoor air temperatures depending on their occupancy classification:

Indoor air temperature of 22°C for Group B (Division 2 or 3 *occupancies*) or Group C (*residential occupancies*) *buildings* at the outside design conditions.

Minimum indoor air temperature of 18°C or commensurate with the use for all other *buildings* at the outside design conditions.

Outside Design Conditions

Sentence 6.2.1.7.(1) states that the outside conditions to be used in designing heating, ventilating and *air-conditioning* systems are to be determined in conformance to Supplementary Standard SB-1.

The outdoor conditions to be used in designing heating, ventilating and *air-conditioning* systems are to be the appropriate values for the Municipality as set out in Supplementary Standard SB-1, using 2.5 per cent design temperature criteria.

An example page from Supplementary Standard SB-1 is given. By finding the appropriate row for the Municipality or location of the *building*, or the nearest location, you can find the appropriate 2.5 per cent design temperature in Column 2.

TABLE 2-1

Location	Design Temperature				Degree Days Below 18°C	15 Min Rainfall, mm	One Day Rainfall, 1/50, mm	Annual Rainfall, mm	Annual Total Precipitation, mm	Driving Rain Wind Pressures, Pa, 1/5	Snow Load, kPa, 1/50		Hourly Wind Pressures, kPa		Seismic Data				
	January		July 2.5%										1/10	1/50	$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	PGA
	2.5%, °C	1%, °C	Dry, °C	Wet, °C							S_s	S_r							
Ailsa Craig	-17	-19	30	23	4000	25	103	800	950	180	2.2	0.4	0.40	0.55	0.16	0.082	0.044	0.012	0.092
Ajax	-20	-22	30	23	4000	23	92	760	825	160	1.0	0.4	0.43	0.57	0.22	0.110	0.058	0.015	0.120
Alexandria	-24	-26	30	23	4600	28	103	800	975	160	2.4	0.4	0.30	0.40	0.68	0.330	0.140	0.046	0.420
Alliston	-23	-25	29	23	4400	28	113	690	875	120	2.0	0.4	0.22	0.33	0.17	0.092	0.048	0.013	0.087
Almonte	-26	-28	30	23	4850	25	86	730	800	140	2.5	0.4	0.30	0.41	0.58	0.280	0.120	0.039	0.370
Armstrong	-39	-42	28	21	7050	23	97	525	725	100	2.7	0.4	0.21	0.27	0.12	0.056	0.023	0.006	0.059
Amprior	-27	-29	30	23	4800	23	86	630	775	140	2.5	0.4	0.27	0.37	0.64	0.310	0.130	0.043	0.400
Atikokan	-34	-37	29	22	6100	25	103	570	760	100	2.4	0.3	0.21	0.27	0.12	0.056	0.023	0.006	0.059
Aurora	-21	-23	30	23	4300	28	108	700	800	140	2	0.4	0.30	0.44	0.19	0.100	0.052	0.014	0.100
Bancroft	-27	-29	29	22	4900	25	92	720	900	100	3.1	0.4	0.23	0.32	0.26	0.150	0.071	0.022	0.130
Barrie	-24	-26	29	22	4600	28	97	700	900	120	2.5	0.4	0.21	0.33	0.16	0.094	0.049	0.014	0.076
Barriefield	-22	-24	27	23	4250	23	113	780	950	160	2.1	0.4	0.35	0.47	0.29	0.160	0.083	0.023	0.160
Beaverton	-24	-26	30	22	4550	28	106	720	950	120	2.2	0.4	0.24	0.36	0.16	0.100	0.053	0.015	0.078
Belleville	-22	-24	29	23	4100	23	103	760	850	180	1.7	0.4	0.32	0.43	0.26	0.140	0.073	0.020	0.140
Belmont	-17	-19	30	23	4050	25	97	850	950	180	1.7	0.4	0.35	0.51	0.20	0.098	0.048	0.013	0.130
Big Trout Lake	-38	-40	25	20	7650	13	92	400	600	150	3.2	0.2	0.33	0.42	0.12	0.056	0.023	0.006	0.059
CFB Borden	-23	-25	29	22	4550	28	113	690	875	120	2.2	0.4	0.21	0.33	0.16	0.090	0.046	0.013	0.081
Bracebridge	-26	-28	29	22	4850	25	103	830	1050	120	3.1	0.4	0.26	0.35	0.18	0.110	0.053	0.016	0.078
Bradford	-23	-25	30	23	4400	28	108	680	800	120	2.1	0.4	0.24	0.36	0.18	0.097	0.050	0.014	0.093
Brampton	-19	-21	30	23	4250	28	119	720	820	140	1.3	0.4	0.32	0.44	0.26	0.120	0.052	0.015	0.180
Brantford	-17	-19	30	23	3950	23	103	780	850	160	1.3	0.4	0.31	0.40	0.24	0.120	0.052	0.014	0.160
Brighton	-21	-23	29	23	4200	23	97	760	850	160	1.6	0.4	0.42	0.54	0.25	0.130	0.068	0.018	0.140
Brockville	-23	-25	29	23	4275	25	103	770	975	180	2.2	0.4	0.32	0.44	0.40	0.200	0.100	0.030	0.220
Burk's Falls	-26	-28	29	21	5100	25	103	810	1010	120	2.7	0.4	0.26	0.35	0.21	0.120	0.057	0.018	0.110
Burlington	-17	-19	31	23	3775	23	103	770	850	160	0.9	0.4	0.36	0.46	0.36	0.180	0.063	0.020	0.270
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

EXAMPLE QUESTION

What is the 2.5% January outside design condition temperature for a building located in Alliston Ontario?

a) –23°C;
b) –26°C;
c) –25°C;
d) 29°C.

OBC Reference _____

TABLE 2-2

Location	Design Temperature				Degree Days Below 18°C
	January		July 2.5 %		
	2.5 %, °C	1 %, °C	Dry, °C	Wet, °C	
Ailsa Craig	-17	-19	30	23	4 000
Ajax	-20	-22	30	23	4 000
Alexandria	-24	-26	30	23	4 600
Alliston	**-23**	**-25**	**29**	**23**	**4 400**
Almonte	-26	-28	30	23	4 850
Column 1	2	3	4	5	6

EXERCISE #2-1

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. What is the value for Degree Days Below 18 °C for Beaverton, Ontario?
   a) 4 550;
   b) 5 400;
   c) 950;
   d) 4 100.

OBC Reference _____

2. What is the minimum indoor air temperature required for movie theatres?
    a) 22 °C;
    b) 20 °C;
    c) 18 °C;
    d) To good engineering practice.

OBC Reference _____

3. What edition of the ASHRAE HVAC Systems and Equipment is applicable for conformance to the 2006 OBC?
    a) 2003;
    b) 2004;
    c) 2005;
    d) 2006.

OBC Reference _____

INSTALLATION STANDARDS – ALL BUILDINGS

Installation standards are described in Article 6.2.1.4.

Earth Energy Systems

The design and installation of earth energy systems, where such systems use groundwater, submerged heat exchangers or ground heat exchangers, are to conform to CAN/CSA-C448.2-M, "Design and Installation of Earth Energy Systems for Residential and Other Small Buildings" when the system serves:

- single *dwelling units*, or
- *buildings where the conditioned* space is not more than 1 400 m^2.

Where the heated floor space area is more than 1 400 m^2, the design and installation of earth energy systems (such as ground and water source heat pumps) is to conform to CAN/CSA-C448.1-M, "Design and Installation of Earth

Energy Systems for Commercial and Institutional Buildings".

Solid Fuel-Burning Appliances

The design and installation of all solid fuel-burning *appliances* is to conform to:

- CAN/CSA-B365-M, "Installation Code for Solid Fuel-Burning Appliances and Equipment" and,
- the manufacturer's installation instructions.

Solid fuel-burning appliances for central heating systems must also conform to CAN/CSA-B366.1-M, "Solid Fuel-Fired Central Heating Appliances".

Hydronic Heating Systems

Sentence 6.2.1.4.(6) states that the design and installation of hydronic heating systems shall conform to CAN/CSA-B214, "Installation Code for Hydronic Heating Systems", or other good engineering practice.

Fireplaces – All Buildings

Fireplaces are to conform to the requirements of OBC Section 9.22. Fireplaces.

Heat Recovery Ventilators – All Buildings

Heat recovery ventilators with rated capacities of not less than 25 L/s and not more than 200 L/s are to be installed in accordance with Article 9.32.3.11. with the following exception:

Where *electric space heating*, other than forced-air electric heating system, is provided in *buildings* of *residential occupancy* (within the scope of Part 9), the mechanical ventilation system must include heat recovery ventilators designed to provide a heat recovery efficiency the greater of:

- the minimum rated efficiency required by the *Energy Efficiency Act*, or
- a minimum 55% sensible heat recovery efficiency when tested to the low temperature thermal and ventilation performance test method set out in CAN/CSA-C439, "Test for Rating the Performance of Heat/Energy-Recovery Ventilators", at a Station 1 test temperature of

–25°C at an air flow not less than 30 L/s.

Where a heat recovery ventilator is installed to conform to OBC 9.32.3 Mechanical Ventilation (self-contained system serving one *dwelling unit* – see Module 6), it is required to have a minimum 55% sensible heat recovery efficiency when tested to the conditions described above.

Heat recovery ventilators with rated capacities equal to or greater than 200 L/s are to be installed in accordance with good engineering practice.

EXAMPLE QUESTION

Which of the following earth energy systems must conform to CAN/CSA-C448.1-M, "Design and Installation of Earth Energy Systems for Commercial and Institutional Buildings"?

a) A school with a floor area of 1200 m^2;
b) Single family residence, 400 m^2;
c) Office building with a floor area of 1800 m^2;
d) Strip mall, 13 tenants, 100 m^2 heated floor area each.

OBC Reference _____

EXERCISE #2-2

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. The installation of solid fuel-burning appliances for central heating systems is specifically required to comply with CAN/CSA-B365-M and which of the following?
   a) Good engineering practice;
   b) Part 9 OBC;
   c) The manufacturer's installation instructions;
   d) CAN/CSA-B214.

OBC Reference _____

2. Fireplaces are to conform to?:
    a) CAN/CSA-B365-M;
    b) OBC Section 9.22;
    c) OBC Part 11;
    d) Minimum 55% sensible heat recovery efficiency.

OBC Reference _____

3. In which of the following *buildings* may a 50 L/s heat recovery ventilator be subject to the minimum rated efficiency required by the *Energy Efficiency Act*?
    a) Single-family home, electric baseboard heating;
    b) Single-family home, forced-air electric heating;
    c) Dentist office, under 600 m^2 area, baseboard electric heating;
    d) Single family home, forced air gas heating.

OBC Reference _____

4. To which of the following requirements would a residence equipped with a wood furnace for central heating conform?
    a) CAN/CSA-B365-M;
    b) CAN/CSA-B366.1-M;
    c) CAN/CSA-B365-M and CAN/CSA-B366.1-M;
    d) CSA-364-M

OBC Reference _____

INSTALLATION – ALL BUILDINGS
GENERAL REQUIREMENTS

Article 6.2.1.8. requires that equipment requiring periodic maintenance and forming part of a heating, ventilating or *air-conditioning* system is to be installed with provision for access for inspection, maintenance, repair and cleaning.

Mechanical equipment must be protected with *guards* to prevent injury to persons.

Equipment forming part of a heating or *air-conditioning* system that may be adversely affected by freezing temperatures is to be protected from freezing.

EXPANSION, CONTRACTION AND SYSTEM PRESSURE

Heating and cooling systems are to be designed to allow for expansion and contraction of heat transfer fluid and to maintain system pressure within the rated working pressure limits of all components of the system.

ASBESTOS

Asbestos must not be used in air distribution systems or equipment in a form or in a location where asbestos fibres could enter the air supply or return systems.

ACCESS OPENINGS

Any covering of an access opening through which a person could enter must be openable from the inside without the use of keys where there is a possibility of the opening being accidentally closed while the system or equipment is being serviced.

COMBUSTIBLE TUBING

Combustible tubing for pneumatic controls may be used in *buildings* required to be of *noncombustible construction* providing it has an outside diameter not exceeding 10 mm.

EXAMPLE QUESTION

A common way to allow for expansion and contraction in heating and cooling systems is by which of the following methods?

a) Manual control valve;
b) Safety relief valve;
c) Expansion tank;
d) Guard to prevent injury.

OBC Reference _____

EXERCISE #2-3

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. What characteristic of asbestos prevents its use in locations where it could enter the air supply or return system?
   a) Combustibility;
   b) Air transportable fibres;
   c) Brittleness;
   d) Low strength.

   OBC Reference _____

2. Heating, ventilating or *air-conditioning* equipment requiring periodic maintenance is to be provided with which one of the following?
   a) Internal lighting;
   b) Lockable doors;
   c) Access;
   d) Easily cleaned components.

   OBC Reference _____

3. Which of the following diameters of *noncombustible* tubing for pneumatic controls may be used in buildings required to be of *noncombustible construction*?
    a) 10 mm;
    b) 100 mm;
    c) 11 mm;
    d) all diameters.

OBC Reference _____

REQUIRED VENTILATION – ALL BUILDINGS

Subsection 6.2.2. deals with ventilation in general. Generally, all *buildings* are to be ventilated. The rates at which outdoor air is supplied to *buildings* by ventilation systems are to be not less than the rates required by ASHRAE Standard 62, "Ventilation for Acceptable Indoor Air Quality", except for *storage garages* and *repair garages*, which have separate requirements.

Self-contained mechanical ventilation systems, that serve only one *dwelling unit*, are considered to satisfy the OBC for required ventilation if they conform to the requirements of OBC 9.32.3. Mechanical Ventilation (see Module 6).

NATURAL VENTILATION – ALL BUILDINGS

When *buildings* are to be ventilated, the required ventilation must be provided by mechanical ventilation, except that it can be provided by natural ventilation or a combination of natural and mechanical ventilation in:

- *buildings* of other than *residential occupancy* having an *occupant load* of not more than one person per 40 m^2 during normal use,
- *buildings* of *industrial occupancy* where the nature of the process contained therein permits or requires the use of large openings in the *building* envelope even during the winter, or
- seasonal *buildings* not intended to be occupied during the winter.

Where climatic conditions permit, *buildings* containing *occupancies* other than *residential occupancies*, may be ventilated by natural ventilation methods in lieu of mechanical ventilation where engineering data demonstrates that such a method will provide the required ventilation for the type of *occupancy*. The engineering data might include the percentage of wall openings and their exposure, the climatic conditions of temperature, wind speed and wind direction, the height and depth of the building, and a calculation of the expected air changes.

There are specific requirements for the natural ventilation of rooms and spaces in *residential occupancies* as described in OBC 9.32.2. Natural Ventilation (see Module 6).

AIR CONTAMINANTS – ALL BUILDINGS

Air contaminants released within *buildings* are to be removed as much as possible at their points of origin and must not be permitted to accumulate in concentrations greater than permitted in the ACGIH Industrial Ventilation Manual.

Systems serving spaces that contain sources of contamination and systems serving other occupied parts of the *building* but located in or running through spaces that contain sources of contamination must be designed in such a manner as to prevent spreading of contamination to other occupied parts of the *building*.

Heating, ventilating and *air-conditioning* systems must be designed to minimize growth of micro-organisms according to good engineering practice described in the OBC.

Mechanical rooms containing refrigeration equipment are required to be ventilated in accordance with CSA B52, "Mechanical Refrigeration Code".

CRAWL SPACES AND ATTIC OR ROOF SPACES – ALL BUILDINGS

Every crawl space and every *attic or roof space* requires ventilation by natural or mechanical means.

Buildings classified under OBC Part 9 may meet this requirement by conformance to OBC 9.18. Crawl Spaces

(see Module 6) and OBC 9.19. Roof Spaces.

EXAMPLE QUESTION

Under which design condition may rooms and spaces in *buildings* be ventilated in accordance to requirements other than OBC Part 6?

Self-contained mechanical ventilation systems, serving only one suite in a business occupancy;

a) Any assembly occupancy occupying an area less than 100 square meters;
b) Self-contained mechanical ventilation systems; serving only one dwelling unit;
c) Self-contained mechanical ventilation systems, serving only one live/work unit.

OBC Reference _____

EXERCISE #2-4

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. Which of the following rooms and spaces are NOT required to conform to the outdoor air rates published by ASHRAE Standard 62?
    a) Apartments with central washroom exhaust;
    b) Department store less than 600 m^2 area;
    c) A self-contained hotel *suite;*
    d) Vehicle *repair garage* greater than 600 m^2 area.

OBC Reference _____

2. Which of the following buildings can be ventilated by natural ventilation alone?
    a) A house of 160 m^2 area, *occupant load* of 4 persons;
    b) A warehouse of 1600 m^2 area *occupant load* of 4 persons;
    c) An artist's apartment containing large openable windows in the building envelope;
    d) A self-contained *dwelling unit*.

OBC Reference _____

Ontario

Ministry of Municipal Affairs and Housing

HVAC-HOUSE

PARTICIPANT'S MODULE #3

Air Ducts for Low Capacity Systems

May 2008

INTRODUCTION

This module focuses on low capacity air duct distribution systems – standards, design, and installation. Plenum and connected duct clearances are examined for various rated furnaces. Intake and exhaust openings are all reviewed for OBC requirements. Accessories such as filters, outlets, diffusers, and balancing dampers are examined as well as make-up air and filters.

OBJECTIVES

Upon completion of this module, participants will:

- Explain the concept of low capacity systems;
- Describe the material requirements of duct design;
- Know and understand the requirements of duct and plenum construction including coverings, linings, insulation, tape, balance dampers, and in slabs-on-ground;
- Determine the requirements for warm-air supply outlets;
- Identify required clearances of ducts and plenums;
- Explain the requirements for make-up air, intake and exhaust air openings;
- Cite the requirements and standards for air filters and equipment.

AIR DUCTS FOR LOW CAPACITY SYSTEMS

Subsection 6.2.3. does not apply to dwelling units within the scope of Part 9, however, 6.2.3 still applies to dwelling units that are in a Part 3 building. Subsection 6.2.4. deals with air ducts for low capacity systems, or in other words, systems that serve individual dwelling units within the scope of Part 9. Glance at these two subsections now and read through the article headings to get an overview of each subsection.

Application

Sentence 6.2.4.1.(1) states that Subsection 6.2.4. applies to the design, construction and installation of air duct distribution systems serving heating, ventilating or air-

conditioning systems that serve individual *dwelling* units within the scope of Part 9.

This module examines the design, construction and installation of air duct distribution systems that serve these low capacity systems.

Materials in Air Duct Systems

Sentence 6.2.4.2.(1) refers us to Article 6.2.3.2. for the materials in *supply ducts*. Except as described below, all ducts, duct connectors, associated fittings and *plenums* used in air duct systems are required to be constructed of steel, aluminum alloy, copper, clay, asbestos-cement or similar *noncombustible* material.

All ductwork and fittings are to be constructed and installed in conformance with SMACNA Manuals and ASHRAE Handbooks, as per Sentence 6.2.3.2.(6). It is important to remember that although industry publications such as the SMACNA manuals address a variety of duct materials, the duct material must first be permitted by the Code for a particular application before using these manuals for construction and installation information.

All duct materials and fittings are required to be suitable for exposure to the temperature and humidity conveyed, and be resistant to corrosion due to any contaminants in the air in the ducts, as per Sentence 6.2.3.2.(7).

Allowable Exceptions for Combustible Duct Materials Serving Individual Dwelling Units

Ducts, associated fittings and *plenums* are permitted to contain *combustible* material provided they conform to the appropriate requirements for Class 1 duct materials in CAN/ULC-S110-M, "Tests for Air Ducts"

Combustible duct sealants are permitted if they have a *flame-spread rating* of not more than 25 and a smoke developed classification of not more than 50.

As will be seen under the Return-Air System topic, *return ducts* are to be constructed of material having a surface *flame-spread rating* of not more than 150. This allows the *designer* of house type systems the flexibility of utilizing stud

and joist spaces for return air ducting as an economical alternative to *noncombustible* material.

Duct connectors that are used between ducts and air outlet units are permitted to contain *combustible* materials if they conform to the appropriate requirements for Class 1 air duct materials in CAN/ULC-S110-M, "Tests for Air Ducts" and,

- are limited to 4 m in length,
- are used only in horizontal runs, and
- do not penetrate required *fire separations*.

Excessive Moisture

Sentence 6.2.3.2.(5) emphasizes that the above allowable materials when used in a location where they may be subjected to excessive moisture must have no appreciable loss of strength when wet and are to be corrosion-resistant.

Duct Design – Steel and Aluminum Supply Ducts

Galvanized steel or aluminum *supply ducts* are required to conform to Table 6.2.4.2.

Table 6.2.4.2.
Minimum Metal Thickness of Ducts
Forming Part of Sentence 6.2.4.2.(2)

TABLE 3-1

Type of Duct	Maximum Diameter, mm	Maximum Width or Depth, mm	Minimum metal thickness, mm	
			Duct Material	
			Galvanized Steel	Aluminum
Round ducts serving single *dwelling units*	125 or less	—	0.254	0.30
Round	350 over 350	— —	0.33 0.41	0.30 0.41
Rectangular, enclosed	— —	350 over 350	0.33 0.41	0.30 0.41
Rectangular, not enclosed, for single *dwelling units*, with required clearance up to 12 mm	— —	350 over 350	0.33 0.41	0.41 0.48
Rectangular, not enclosed, with required clearance of more than 12 mm	— —	350 over 350	0.41 0.48	0.41 0.48
Column 1	2	3	4	5

The design of fittings for ducts is required to conform to SMACNA, "HVAC Duct Construction Standards — Metal and Flexible", except that metal thickness is to conform to Table 6.2.4.2.

EXAMPLE QUESTION

Duct connectors that contain *combustible* materials and conform to OBC requirements may be used to connect?

a) Main and branch ducts, limited to 4 m length;
b) Horizontal ducts and air outlet units, 2 m length;
c) Equipment drains and plumbing;
d) Vertical ducts and air outlet units, 1 m length.

OBC Reference _____

EXERCISE #3-1

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. When allowable duct materials are used in a location where they may be subjected to excessive moisture, which one of the following characteristics is required by the OBC?
   a) Non-ferrous;
   b) Plastic;
   c) Equal wet/dry strength;
   d) Used only in horizontal runs.

OBC Reference _____

2. All ductwork and fittings are required to be constructed and installed in conformance with:
   a) SMACNA Manuals and ASHRAE Handbooks;
   b) *CAN/ULC-S110-M;*
   c) ANSI/ASHRAE 62;
   d) ACGIH Industrial Ventilation Manual.

OBC Reference _____

3. Which one of the following *flame-spread ratings* is acceptable to the OBC for duct sealants?
    a) 50;
    b) 26;
    c) 49;
    d) 25.

OBC Reference _____

4. Table 6.2.4.2 refers to "required clearance" which refers to installed clearance to combustible material. What minimum galvanized steel thickness is required for a rectangular, not enclosed, duct with a dimension of 400 mm width and 300 mm depth and required clearance of 12mm?
    a) 0.48;
    b) 0.30;
    c) 0.41;
    d) 0.254.

OBC Reference _____

CONSTRUCTION AND INSTALLATION OF DUCTS AND PLENUMS

According to Article 6.2.4.3., there are specific OBC requirements for the installation of ducts and plenums as follows:

- Rectangular panels in *plenums* and ducts more than 300 mm wide are to be shaped to provide sufficient stiffness.
- Rectangular duct connections are to be made with "S" and drive cleats or equivalent mechanical connections.
- All round duct joints are to be tight fitting and lapped not less than 25 mm.

Support

Ducts are to be securely supported by metal hangers, straps, lugs or brackets. Wooden brackets may be used where zero

clearance is permitted.

Trunk *supply ducts* are not to be nailed directly to wood members.

Branch ducts are to be supported at suitable spacing to maintain alignment and prevent sagging.

Fire Stopping and Combustible Material

Where the installation of heating *supply ducts* in walls and floors creates a space between the duct and construction material, the space is to be fire stopped with *noncombustible* material at each end.

Combustible ducts in concrete slabs-on-ground that are connected to a *furnace* supply *plenum* are to be located not closer than 600 mm to the *plenum* and not less than 600 mm from its connection to a riser or register.

Moisture and Thermal Protection

Ducts in or beneath concrete slabs-on-ground are to be watertight, corrosion-, decay- and mildew-resistant.

Where a *supply* or *return duct* is not protected by an insulated exterior wall or where the duct is exposed to an unheated space it is to be insulated to provide a thermal resistance of not less than RSI 2.1.

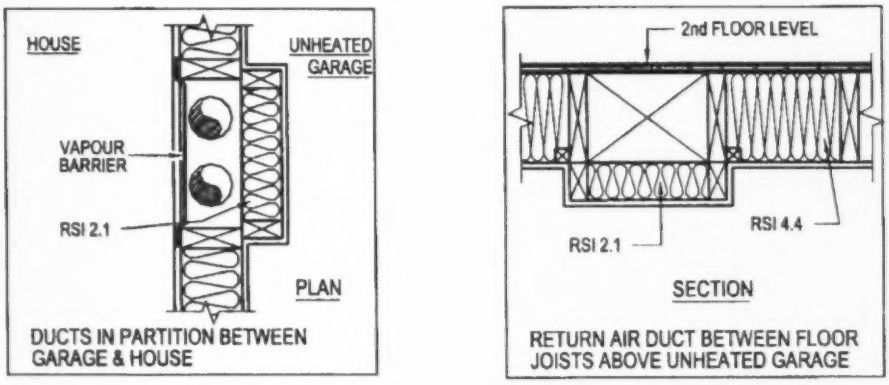


FIGURE 3-1

Ducwork passing through unconditioned spaces must have all joints taped or be otherwise sealed to ensure that the ducts are airtight throughout their length.

Underground ducts have the following requirements, as per Sentences 6.2.4.3.(12) and (13):

- Be constructed and installed to provide interior drainage to all low points;
- Provide a clean-out or pump-out connection at every low point;
- Not be connected directly to a sewer; and
- Be installed and constructed of materials in conformance with ASHRAE Handbooks, SMACNA Manuals and the HRAI Digest.

WARM-AIR SUPPLY OUTLETS

Article 6.2.4.4. contains requirements for the location and design of warm-air supply outlets. In a *dwelling unit*, a warm-air supply outlet is to be provided in each finished room that is located adjacent to unheated space, exterior air or exterior soil. When located adjacent to exterior walls, such outlets are to be located so as to bathe not less than one exterior wall or window with warm air, except in bathrooms, utility rooms or kitchens, where this may not be practical.

As an alternate to floor outlets, where the heating system is also designed to provide ventilation air, ceiling outlets or outlets located high on interior walls may be installed provided the outlets are

- designed for this purpose, and
- installed with diffusers.

Warm-air supply outlets located in finished areas are to be provided with diffusers and adjustable openings and must not be located on a *furnace plenum*.

Number of Outlets Required

Not less than one warm-air supply outlet is to be provided for each 40 m^2 of floor surface area in unfinished *basements*

serving *dwelling units*, located so as to provide adequate distribution of warm air throughout the *basement*.

Not less than one warm-air supply outlet is to be provided for each 80 m^2 of floor surface area in heated crawl spaces serving *dwelling units*, located so as to provide adequate distribution of warm air throughout the crawl space.

Except for pipeless *furnaces* and floor *furnaces*, the capacity of warm-air supply outlets serving *dwelling units* must not be less than the design heat loss from the area served and must not exceed 3 kW per outlet.

In *basements* and heated crawl spaces, the calculated heat gain from the *supply ducts* and *plenum* surfaces may be considered in calculating the design heat loss, as a heat credit.

Maximum Temperature of Supply Air

The temperature of supply air at the warm-air supply outlets must not exceed 70°C.

No Interconnection with Storage Garage

Air duct systems serving *storage garages* must not be interconnected with other parts of the *building*.

Concrete Slabs-on-Ground

Warm-air supply systems for *buildings* of *residential occupancy* built on concrete slabs-on-ground are to be installed in the slab, and are to be of the perimeter loop type or radial perimeter type, as per Article 6.2.4.5.

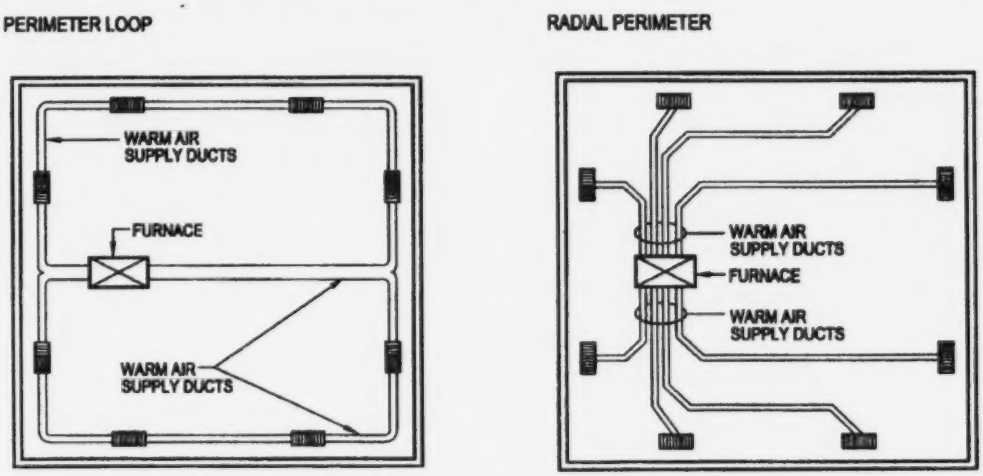


FIGURE 3-2

Adjustable Dampers and Balance Stops

All branch *supply ducts* for residential systems are to be equipped with volume control dampers at the boot to permit balancing or be fitted with a diffuser incorporating an adjustable and lockable volume control device which can be set in a fixed position, as per Article 6.2.4.6.

RETURN-AIR SYSTEM

Article 6.2.4.7. deals with return-air systems. The sections below discuss various aspects of the requirements.

Material and Clearances

The return-air system is to be designed to handle the entire air supply. The *return ducts* are to be constructed of material having a surface *flame-spread rating* of not more than 150, except for the following conditions where *noncombustible* ducts are required for:

- any part of a *return duct* exposed to radiation from the *furnace* heat exchanger or other radiating part of the *furnace*, such as part of a *return duct* directly above or within 600 mm of the outside *furnace* casing, and
- any *return ducts* serving solid fuel-fired *furnaces* are to be constructed of *noncombustible* material.
-

Combustible return ducts are to be lined with *noncombustible* material below floor registers, at the bottom of vertical ducts and under *furnaces* having a bottom return.

Spaces between studs and joists used as *return ducts* are to be separated from the unused portions of such spaces by tight-fitting metal stops or wood blocking.

Vertical Return Duct Openings and Room Air Make-up

A vertical *return duct* is to have openings to return air on not more than 1 floor.

At least one return-air inlet is to be provided in each floor level in a *dwelling unit* except for floor levels that are less than 900 mm above or below an adjacent floor level that is provided with a return-air inlet.

Provision is to be made for the return of air from all rooms by leaving gaps beneath doors, using louvered doors or installing *return duct* inlets.

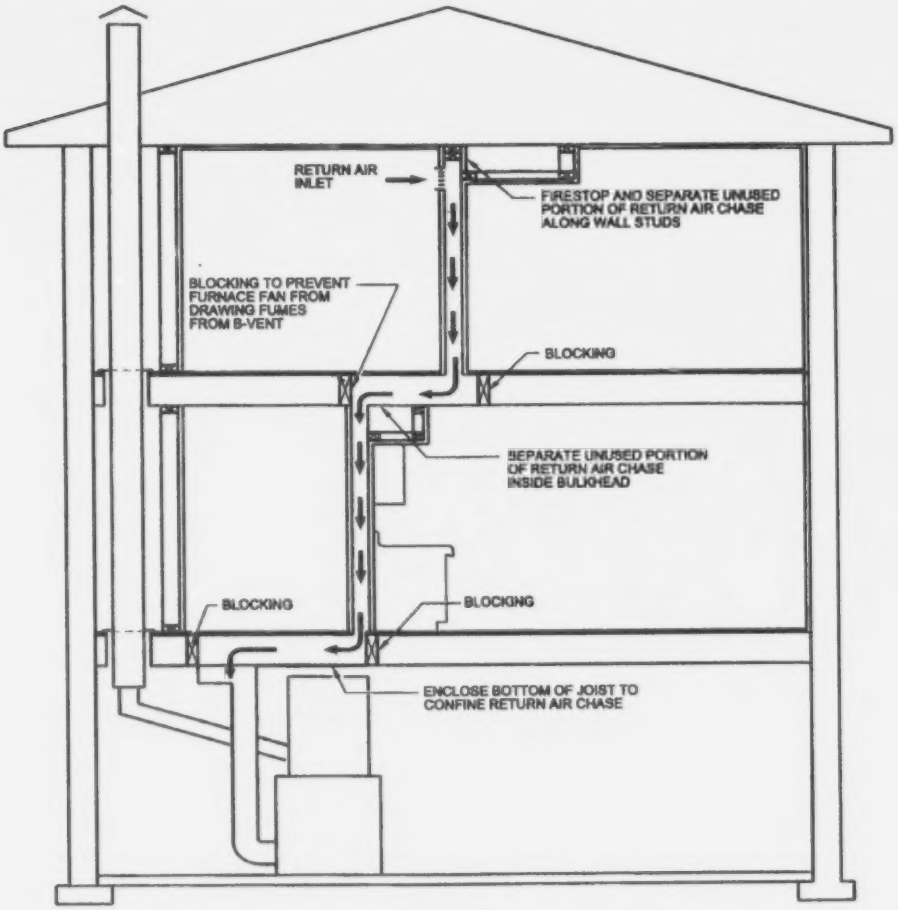


FIGURE 3-3

Negative Pressure and Recirculation

The return-air system is to be designed so that the negative pressure from the circulating fan cannot affect the *furnace* combustion air supply nor draw combustion products from joints or openings in the *furnace* or *flue pipe*. To help meet this requirement, return-air inlets are not permitted in an enclosed room or crawl space that provides combustion air to a furnace, as per Sentence 6.2.4.7.(13).

Return-air from a *dwelling unit* must not be re-circulated to any other *dwelling unit*.

EXAMPLE QUESTION

During the installation of heating *supply ducts* a space between the duct and construction may be created. This space is to be fire stopped in which one of the following ways?

a) With wood blocking material at each end;
b) With noncombustible material, upstream end;
c) With noncombustible material, floors only;
d) With noncombustible material, at each end.

OBC Reference _____

EXERCISE #3-2

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. Which one of the following is a construction requirement for round ducts for OBC low capacity systems
   a) Galvanized steel construction;
   b) Mechanical connections;
   c) Joints lapped not less than 20 mm;
   d) Tight fitting joints.

OBC Reference _____

2. The supply air at warm-air supply outlets must not exceed?
   a) 70 °F;
   b) Good engineering practice;
   c) 70 °C;
   d) RSI 2.1.

OBC Reference _____

3. In a *dwelling unit* a finished room adjacent to an exterior wall has a design heat loss of 6.6 kW, and requires warm air supply. How many outlets are required to conform to capacity requirements of the OBC.
    a) 1 outlet;
    b) Design heat loss in kW divided by 3.0 kW and rounded to the next highest integer;
    c) 2 outlets, if two exterior walls have windows;
    d) 2 outlets.

OBC Reference _____

4. Which one of the following arrangements does the OBC NOT require *combustible* return air ducts to be lined with *noncombustible* material?
    a) Below floor registers
    b) At the bottom of vertical ducts
    c) At wood blocking in a horizontal run
    d) Under *furnaces* having a bottom return

OBC Reference _____

Articles 6.2.4.8. to 6.2.4.11. cover various aspects of low-capacity duct systems, whihch are discussed below.

COVERINGS, LININGS AND INSULATION

Foamed plastic insulation may be used in a ceiling space that acts as a return air *plenum* provided the foamed plastic insulation is protected from exposure to the *plenum* in accordance with requirements described in Article 3.1.5.12. of the OBC. This Article would require a thermal barrier such as gypsum board, to protect the foamed plastic insulation.

Linings of ducts are to be installed so that they will not interfere with the operation of volume or balancing dampers.

Tape

Tape used for sealing joints in air ducts, *plenums* and other parts of air duct systems is to meet the flame-resistance requirements for fabric in CAN/ULC-S109, "Flame Tests of Flame-Resistant Fabrics and Films".

CLEARANCES OF DUCTS AND PLENUMS

Different types and makes of furnaces have different minimum plenum clearances specified by the manufacturer, and this will be indicated on the label on the furnace. The corresponding requirements for the clearances between supply ducts and combustible materials depends on the minimum plenum clearance, and is broken down into 3 cases in Article 6.2.4.10.

Case 1

Where the *plenum* clearance is 75 mm or less, the clearance between a *supply duct* and *combustible* material is

- to be equal to the required *plenum* clearance within 450 mm of the *plenum*, and
- to be not less than 12 mm at a distance of 450 mm or more from the *plenum*, except that this clearance may be reduced to zero beyond a bend or offset in the duct sufficiently large to shield the remainder of the duct from direct radiation from the *furnace* heat exchanger.

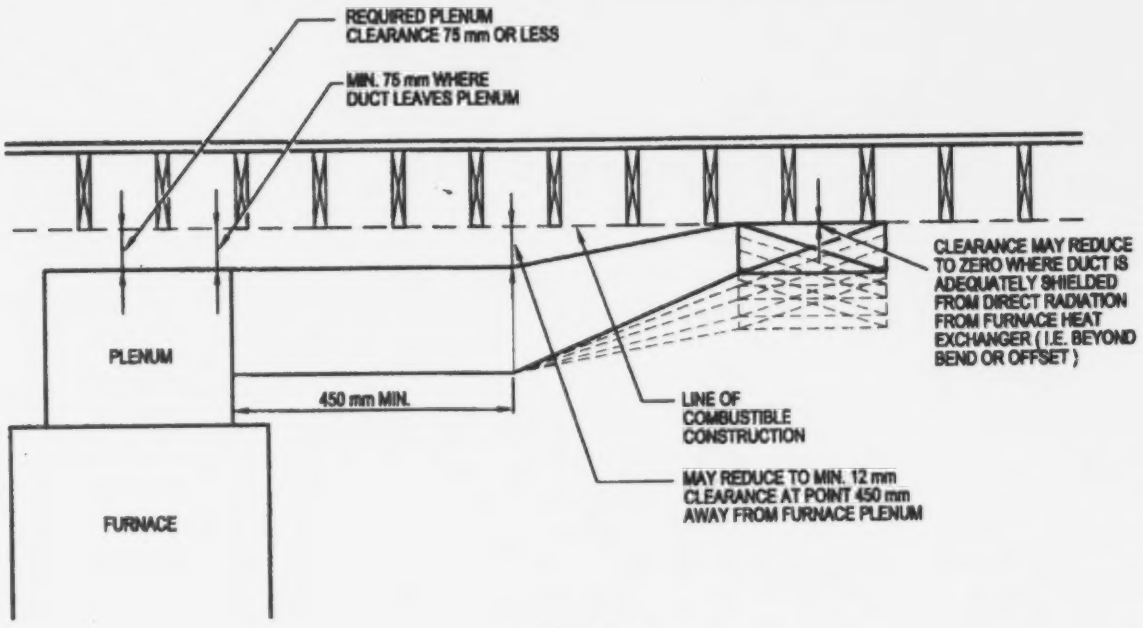


FIGURE 3-4

Case 2

Where the *plenum* clearance is more than 75 mm but not more than 150 mm, the clearance between a *supply duct* and *combustible* material is

- to be equal to the required *plenum* clearance within a horizontal distance of 1 800 mm of the *plenum*, and
- to be not less than 12 mm at a horizontal distance of 1 800 mm or more from the *plenum*, except that this distance may be reduced to zero beyond a bend or offset in the duct sufficiently large to shield the remainder of the duct from direct radiation from the *furnace* heat exchanger.

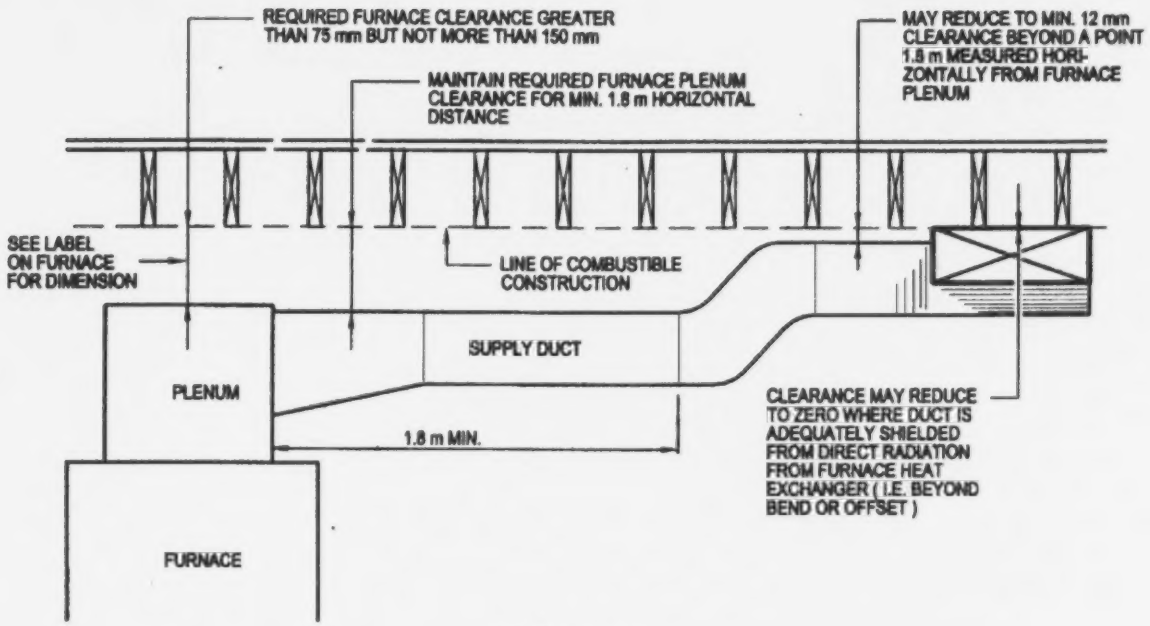


FIGURE 3-5

Case 3

Where the *plenum* clearance is more than 150 mm, the clearance between a *supply duct* and *combustible* material is

- to be equal to the required *plenum* clearance within a horizontal distance of 1 000 mm of the *plenum*,
- to be not less than 150 mm within a horizontal distance between 1 000 mm and 1 800 mm from the *plenum*, and
- to be not less than 25 mm at a horizontal distance of 1 800 mm or more from the *plenum*, except that this distance may be reduced to 8 mm beyond a bend or offset in the duct sufficiently large to shield the remainder of the *supply duct* from direct radiation from the *furnace* heat exchanger.

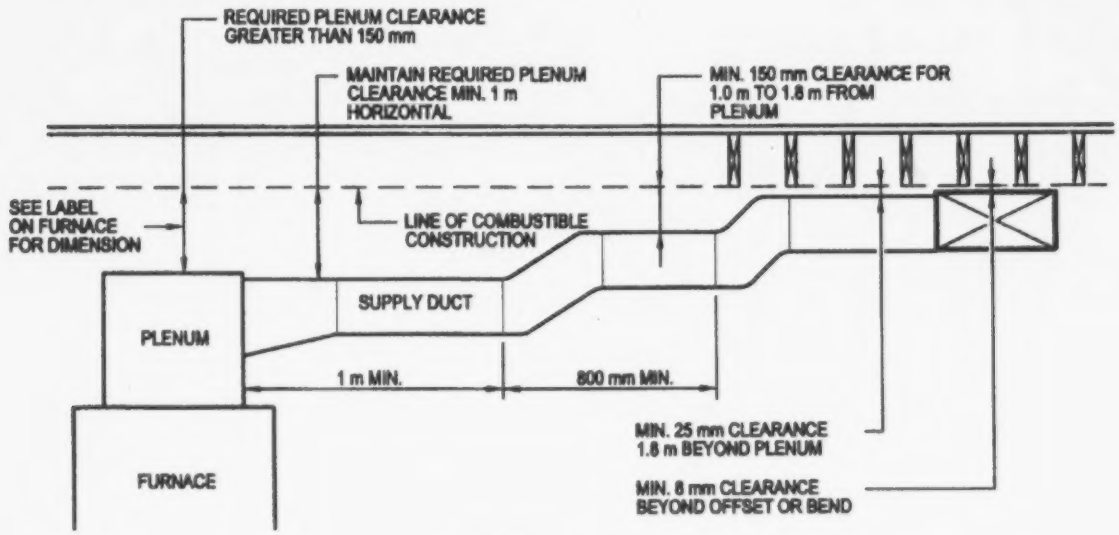


FIGURE 3-6

PIPELESS FURNACE

Where a register is installed in a floor directly over a pipeless *furnace*, a double-walled register box with not less than 100 mm between walls, or a register box with the warm-air passage completely surrounded by the cold-air passage, is be permitted in place of the three clearances conditions listed above.

EXHAUST DUCTS AND OUTLETS

Article 6.2.4.11. addresses exhaust ducts and outlets. Where an *exhaust duct* passes through or is adjacent to unheated space, the duct is to be insulated to prevent moisture or condensation in the duct.

Exhaust outlets must discharge directly to the outdoors, and are to be designed to prevent back draft under wind conditions.

Exhaust ducts directly connected to laundry drying equipment must be independent of other *exhaust ducts*.

EXAMPLE QUESTION

Which one of the following methods is used to determine the required *plenum* clearance for a *furnace*?

a) Use Part 9 OBC;
b) Good engineering practice;
c) Use Part 6 OBC;
d) From equipment data label.

OBC Reference _____

EXERCISE #3-3

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. Where a required *plenum* clearance is 75 mm, which of the following arrangements allows the required *plenum* clearance to be reduced to zero at a point more than 450 mm from the *furnace plenum*?
   a) Insertion of a further 450 mm of plenum;
   b) Insertion of 450 mm of 12 mm clearance;
   c) Insertion of required bend or offset;
   d) Insulation of the *furnace plenum*.

   OBC Reference _____

2. Where a required *plenum* clearance is more than 150 mm, which of the following arrangements allows the required *plenum* clearance to be reduced to zero at a point more than 1.8 m from the *furnace plenum*?
   a) Insertion of a further 1.8 m;
   b) Insertion of 450 mm of 12 mm clearance;
   c) Insertion of required bend or offset;
   d) Zero clearance not allowed.

   OBC Reference _____

3. Where an *exhaust duct* passes through or is adjacent to unheated space, which one of the following requirements is necessary to conform to the OBC?
    a) Provided with insulation;
    b) Provided with a drain hole for condensation;
    c) Duct must be sloped to drain to discharge point;
    d) Provided with a vapour barrier only.

OBC Reference _____

4. *Exhaust ducts* directly connected to laundry drying equipment may be connected to which one of the following?
    a) Washroom exhaust duct;
    b) Kitchen exhaust inlet;
    c) Storage room exhaust;
    d) No connections allowed.

OBC Reference _____

Articles 6.2.4.12. to 6.2.4.14. cover more aspects of low-capacity duct systems, which are discussed below.

MAKE-UP AIR

In ventilating systems that exhaust air to the outdoors, provision must be made for the admission of a supply of make-up air in sufficient quantity so that the operation of the exhaust system and other exhaust equipment or combustion equipment is not adversely affected.

ELECTRIC RESISTANCE HEATING

When electric resistance heating is used to temper make-up air in *buildings* of *residential occupancy* (Part 9 only), the energy rating for windows and sliding glass doors and the minimum thermal resistance of insulation installed must conform to special requirements described in Part 12 of the OBC. These requirements require the windows and doors to have a greater thermal efficiency. However these special OBC requirements need not be met where *electric space*

heating is provided for general heating purposes, or where a heat recovery ventilator is installed that meets the minimum rating requirements discussed earlier in this module.

SUPPLY, RETURN, INTAKE AND EXHAUST AIR OPENINGS

Supply, return and exhaust air openings in rooms or spaces are to be protected by grilles having openings of a size that will not allow the passage of a 15 mm diameter sphere.

Outdoor air intakes and exhaust outlets at the *building* exterior are to be designed or located so that the air entering the *building* system will not contain more contaminants than the normal exterior air.

SCREENS

Exterior openings for outdoor air intakes and exhaust outlets are to be shielded from the entry of snow and rain and are to be fitted with corrosion-resistant screens of mesh not larger than 15 mm, except where climatic conditions may require larger openings. These screens are to be accessible for maintenance.

Combustible grilles, diffusers and other devices at wupply and return air openings in walls and ceiling must have a flame spread rating of not more than 200 in bathrooms, and not more than 150 in rooms and spaces other than bathrooms.

AIR FILTERS AND EQUIPMENT

Air filters for air duct systems are to conform to the requirements for Class 2 air filter units as described in CAN4-S111, "Fire Tests For Air Filter Units".

When electrostatic-type filters are used, they are to be installed so as to ensure that the electric circuit is automatically de-energized when filter access doors are opened or when the system circulating fan is not operating.

ODOUR REMOVAL EQUIPMENT

When odour removal equipment of the adsorption type is used it is to be installed to provide access so that adsorption material can be reactivated or renewed, and be protected from dust accumulation by air filters installed on the air inlet side.

Complete the next exercise.

EXAMPLE QUESTION

Which one of the following ventilation system types requires make-up air?

a) De-humidifier using mechanical refrigeration;
b) System exhausts air to the outdoors;
c) System does not exhaust air to the outdoors;
d) System recycles and heats air only.

OBC Reference _____

EXERCISE #3-4

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. Which one of the following intake air opening locations will likely result in the air entering a *building* system to contain more contaminants than the normal exterior air?

   a) Roof penthouse wall;
   b) Window well at grade adjacent to garden area;
   c) Wall adjacent to shipping and receiving docks;
   d) None of these locations.

OBC Reference _____

2. Supply, return and exhaust air openings in rooms or spaces are to be protected by grilles having openings of a size that will not allow the passage of which one of the following?
    a) Adsorption filter material;
    b) 15 mm diameter sphere;
    c) 13 mm diameter sphere; (due to climatic conditions)
    d) 15 mm diameter disk

OBC Reference _____

3. Which one of the following air intake and outlet screen characteristics does NOT conform to OBC requirements?
    a) Corrosion resistance;
    b) Fitted to an exhaust outlet;
    c) Mesh of 10 mm, due to climatic conditions;
    d) Maintenance accessible.

OBC Reference _____

4. What is the maximum flame spread rating for a plastic diffuser serving a living room in a dwelling unit?
    a) 25;
    b) 50;
    c) 150;
    d) 200.

OBC Reference _____

5. In odour removal equipment, the adsorption material is to be protected from dust accumulation by air filters installed in which one of the following arrangements?
    a) Installed on the air inlet side;
    b) Installed on the air discharge side;
    c) Installed only when the adsorption material is out of the unit being reactivated;
    d) Installed in a manner that, when removed, will automatically de-energize power to the system.

OBC Reference _____

Ontario

Ministry of Municipal Affairs and Housing

HVAC-HOUSE

PARTICIPANT'S MODULE #4

Heating and Cooling Systems – General Requirements

May 2008

INTRODUCTION

This module reviews a variety of safety and installation requirements for various heating and cooling system components. Code requirements cover material standards, protection of structure and occupants as well as equipment configuration and operation.

OBJECTIVES

Upon completion of this module, participants will:

- Identify safe clearances and protective linings for unit heaters and radiator/convector units;
- Know and understand the requirements for piping materials and installation;
- Identify safe clearances to combustible material and recognize surface temperature and protection requirements;
- Describe the requirements for the installation of cooling units;
- Explain the requirement for venting of fuel burning equipment and masonry or concrete chimneys.

UNIT HEATERS - CLEARANCES

Every *unit heater* using either steam or hot water as the heating medium is to be installed with clearances between the *appliance* and adjacent *combustible* material that conform to Table 6.2.9.3.

Table 6.2.9.3.
Clearance between Steam or Hot Water Pipes and Combustible Material
Forming Part of Sentence 6.2.9.3.(1)

TABLE 4-1

Steam or Water Temperature, °C	Minimum Clearance, mm
Not above 95 Above 95 to 120 above 120	No clearance 15 25
Column 1	2

Radiators and Convectors – Lining or Backing

Every steam or hot water radiator and convector located in a recess or concealed space or attached to the face of a wall of *combustible construction* is to be provided with a *noncombustible* lining or backing as per Sentence 6.2.8.1.(1). Steam and hot water radiators and convectors are also required to meet the clearances in Table 6.2.9.3.

PIPING FOR HEATING AND COOLING SYSTEMS

Piping Materials and Support

Under Article 6.2.9.1., piping must be made from materials designed to withstand the effects of temperatures and pressures that may occur in the system. Every pipe used in a heating or *air-conditioning* system is to be installed to allow for expansion and contraction due to temperature changes.

Supports and anchors for piping in a heating or *air-conditioning* system are to be designed and installed to ensure that undue stress is not placed on the supporting structure.

INSULATION OF PIPING FOR HEATING AND COOLING SYSTEMS

Insulation for Human Contact

Pipes and equipment that are subject to human contact must be insulated so that the temperature of the exposed surface does not exceed 70°C, as per Sentence 6.2.9.2.(6).

Insulation and Covering

Article 6.2.9.2. regulates pipe insulation and covering. Insulation and coverings on pipes are to be composed of material suitable for the operating temperature of the system to withstand deterioration from softening, melting, mildew and mould.

Insulation and coverings on pipes in which the temperature of the fluid exceeds 120°C are to be made of *noncombustible* material, or the material shall not flame, glow, smoulder or smoke when tested in accordance with the method of test ASTM C411, "Hot-Surface Performance

of High-Temperature Thermal Insulation". The performance test is to be conducted at the maximum temperature to which the insulation or covering may be exposed to in service.

Combustible Insulation

Where *combustible* insulation is used on piping in a *horizontal* or *vertical service space*, the insulation and coverings on such pipes are to have a *flame-spread rating* throughout the material of not more than 75 in *buildings* of *combustible construction* as per Sentence 6.2.9.2.(3).

Insulation and coverings on piping located in rooms and spaces other than the *service spaces* described above are to have a *flame-spread rating* of not more than that required for the interior finish for the ceiling of the room or space.

Under Sentence 6.2.9.2.(7), no *flame-spread rating* or smoke developed classification limitations are required where *combustible* insulation and coverings are used on piping when such piping is

- located within a concealed space in a wall,
- located in a floor slab, or
- enclosed in a *noncombustible* raceway or conduit.

Clearances – Combustible Materials

Clearances between combustible material and bare pipes carrying steam or hot water are to conform to Table 6.2.9.3.

Table 6.2.9.3.
Clearance between Steam or Hot Water Pipes and Combustible Material
Forming Part of Sentence 6.2.9.3.(1)

TABLE 4-2

Steam or Water Temperature, °C	Minimum Clearance, mm
Not above 95	No clearance
Above 95 to 120	15
above 120	25
Column 1	2

Surface Temperature

Article 6.2.9.4. states that the exposed surface temperature of a steam or hot water radiator must not exceed 70°C unless precautions are taken to prevent human contact.

The Appendix note for Sentence 6.2.9.2.(6) indicates that if pipes above 70°C are out of reach of the public and accessible only to maintenance personnel, it is expected that insulation would not be required for public safety.

Protection of Structure and Materials – High Temperature

Article 6.2.9.5. deals with protection of high temperature pipes. Where a pipe carrying steam or hot water at a temperature above 120°C passes through a *combustible* floor, ceiling or wall, the construction is to be protected by a sleeve of metal or other *noncombustible* material not less than 50 mm larger in diameter than the pipe.

Unprotected steam or hot water pipes that pass through a storage space must be covered with not less than 25 mm of *noncombustible* insulation to prevent direct contact with the material stored.

EXAMPLE QUESTION

Insulation and coverings on pipes are to be composed of material suitable for the operating temperature of the system to withstand deterioration. Which of the following deterioration consequences is NOT subject to prevention by the requirements of the OBC?

a) Softening;
b) UV deterioration;
c) Melting;
d) Mildew and mould.

OBC Reference _____

EXERCISE #4-1

Read the following questions and select the correct answer. For each answer provide an OBC reference.

1. The OBC requires pipes that are exposed to human contact be insulated so that?
    a) The transported fluid does not exceed 70°C;
    b) The pipe insulation surface does not melt;
    c) The exposed surface does not exceed 70°C;
    d) The exposed surface does not exceed 120°C.

OBC Reference _____

2. Which one of the following design arrangements in *combustible construction* is NOT addressed by the OBC requirement for lining or backing of a radiator or convector?
    a) Attached to the face of a wall;
    b) Freestanding not attached to the wall;
    c) Freestanding in a recess space;
    d) Located in a concealed space.

OBC Reference _____

3. Where *combustible* insulation is used on piping in a *horizontal* or *vertical service space* in buildings of *combustible construction*, the insulation and coverings are to have a *flame-spread rating* of not more than?
    a) That required for the interior finish for the ceiling of the room or space;
    b) 70;
    c) 75;
    d) No *flame-spread rating* required.

OBC Reference _____

4. The OBC requires insulation and coverings on certain pipes to not flame, glow, smoulder or smoke when tested in accordance with the method of test ASTM C411, "Hot-Surface Performance of High-Temperature Thermal Insulation". At what temperature is the performance test conducted on the insulation to conform to OBC requirements?
    a) The maximum exposed service temperature;
    b) 120°C;
    c) To a maximum surface temperature of 70°C;
    d) 120°F.

OBC Reference _____

REFRIGERATING SYSTEMS & EQUIPMENT FOR AIR-CONDITIONING

Cooling Units

Under Article 6.2.10.1., where a cooling unit is combined with a fuel-fired *furnace* in the same duct system, the cooling unit is to be installed:

- in parallel with the heating *furnace*,
- upstream of the *furnace* provided the *furnace* is designed for such application, or
- downstream of the *furnace* provided the cooling unit is designed to prevent excessive temperature or pressure in the refrigeration system.

STORAGE BINS

Subsection 6.2.11. addresses storage bins for solid fuel (such as wood) or for ash. Service pipes passing through a storage bin for solid fuel are to be protected or so located as to avoid damage to the pipes.

Except for fuel-thawing pipes, every pipe designed to operate at a temperature of 50°C or above must be located where fuel cannot be stored in contact with it.

A storage bin for solid fuel must not be located above a sewer opening or drain opening.

Storage bins for solid fuel are to be designed and constructed so that the air temperature in the bin or the surface temperature of any part of the floor or walls is below 50°C.

ASH STORAGE BINS

Every ash storage bin is to be constructed of *noncombustible* material.

Every opening in an ash storage bin is to be protected by a tight-fitting metal door with metal frame securely fastened to the bin.

CHIMNEYS AND VENTING EQUIPMENT – REQUIREMENT FOR VENTING

The products of combustion from solid fuel-burning *appliances* are to be vented in conformance with the requirements of CAN/CSA-B365-M, "Installation Code for Solid Fuel-Burning Appliances and Equipment". Article 6.3.1.1. references back to Article 6.2.1.4. for the appropriate standard.

MASONRY OR CONCRETE CHIMNEYS

Rectangular *masonry or concrete chimneys* not more than 12 m in height are to conform to Part 9 of the OBC if they serve *appliances* with a combined total rated heat output of 120 kW or less, or that serve fireplaces. Larger chimneys, which are generally not found on houses, would need to comply with an NFPA Standard, as per Article 6.3.1.2.

EXAMPLE QUESTION

A cooling unit is combined with fuel-fired furnace in the same duct system, and is installed downstream of the furnace. Which of the following physical characteristic(s) must be considered in the design of the refrigeration system? (more than one may apply)

a) Air humidity;
b) Air pressure;
c) Air temperature;
d) Air dust level.

OBC Reference _____

EXERCISE #4-2

Read the following questions and select the correct answer. For each answer provide an OBC reference.

1. Where a cooling unit is combined with a fuel-fired *furnace* in the same duct system, which one of the following arrangements does NOT have additional conditions for installation?
   a) Cooling unit installed upstream;
   b) Cooling unit installed parallel;
   c) Cooling unit installed downstream;
   d) All arrangements are permitted without additional conditions.

OBC Reference _____

2. Which one of the following temperatures does NOT conform to the OBC requirement for storage bins, in the bin or for the surface temperature of any part of the floor or walls?
   a) 50°F;
   b) 50°C;
   c) 40°C;
   d) 40°F.

OBC Reference _____

3. An enclosed ash storage bin is located in a *building*. The ash storage bin must be constructed out of which materials?
    a) *Combustible* only;
    b) *Combustible* and *Noncombustible*;
    c) *Combustible* or *Noncombustible*;
    d) *Noncombustible* only.

OBC Reference _____

4. Which one of the following is to be vented in conformance with the requirements of CAN/CSA-B365-M, "Installation Code for Solid Fuel-Burning Appliances and Equipment?
    a) Fuel burning *appliance*;
    b) Masonry fireplace;
    c) Woodstove;
    d) Direct-vented water heater.

OBC Reference _____

Ontario

Ministry of Municipal Affairs and Housing

HVAC-HOUSE

PARTICIPANT'S MODULE #5

Heat Transfer, Air Leakage and Condensation Control

May 2008

INTRODUCTION

This module examines the importance of building assemblies and envelopes in the control of air leakage and condensation, determine the required minimum thermal resistance of insulation, and review the concepts of *air barrier* and vapour barrier systems. This module is included in this course since the performance of the building envelope and of HVAC systems are closely related. The interaction of these systems will impact building function and durability, and comfort for the occupants.

OBJECTIVES

Upon completion of this module, participants:

- Articulate the importance of permeability;
- Determine the required minimum thermal resistance of insulation for a *building*;
- Know and understand the standards for insulation materials and their installation;
- Define and communicate the concept of an *air barrier system*;
- Define and communicate the concept of vapour barrier.

HEAT TRANSFER, AIR LEAKAGE AND CONDENSATION CONTROL

Application

Section 9.25. deals with heat transfer, air leakage and condensation control. This module discusses the application of thermal insulation and measures to control condensation, heat transfer and air leakage for *buildings* of *residential occupancy* (covered under the scope of Part 9 OBC) and intended for use on a continuing basis during the winter months.

The OBC provides exclusions for *buildings* (9.36.2.1.) used as seasonal recreational *buildings*, in particular to this module, thermal insulation, vapour barrier and air-barrier construction need not be provided. However, where any of

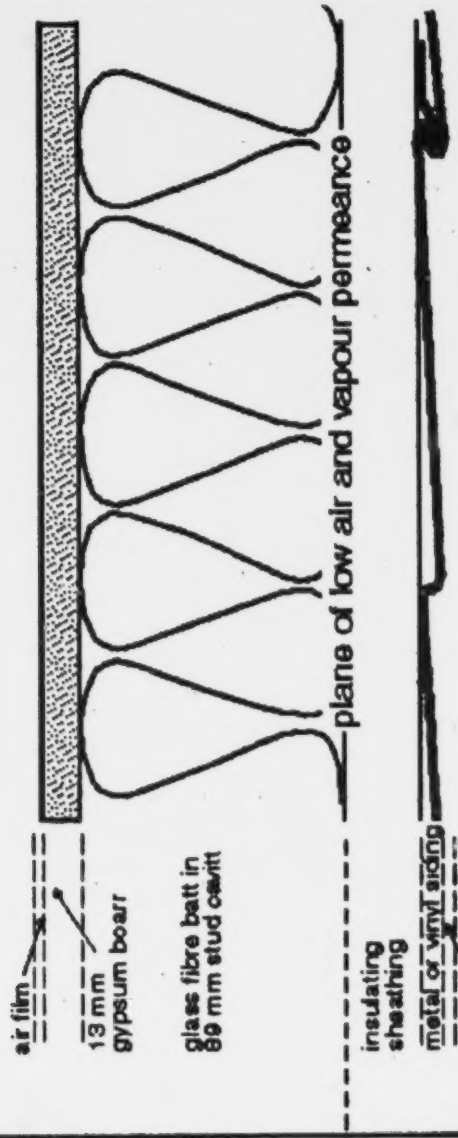
these are provided in the *building*, they are to comply with the full requirements of Part 9 OBC (further exception for thermal insulation, where provided, the minimum thermal resistance of insulation in Table 12.3.2.1. need not be provided).

This module does not apply to insulation and sealing of heating and ventilating ducts.

Low Permeance Sheathing – Water Vapour & Air

As per Article 9.25.1.2., any sheet or panel type material with an air leakage characteristic less than 0.1 l/(s·m^2) at 75 Pa and water vapour permeance less than 60 ng/(Pa·s·m^2) can be considered "low-permeance" against the passage of water vapour and air. Where this type of material is incorporated in a *building* assembly design to meet the minimum insulation value required by the OBC, it is to be installed

- on the warm face of the assembly, thereby preventing condensation of water vapour in the assembly,
- at a location where the ratio between the total thermal resistance of all materials outboard of its innermost low permeance surface and the total thermal resistance of all materials inboard of that surface is not less than required in Table 9.25.1.2., (the ratio ensures that the low permeance surface is close enough to the warm face of the assembly to prevent condensation of water vapour in the assembly), or



	Inboard			Outboard		
RSI value	0.12	0.08	2.11	0.87	0.12	0.03
Total RSI value	2.31			1.02		
Ratio	$\frac{1.02}{2.31} = 0.44$					

FIGURE 5-1

- outboard of an air space that is vented to the outdoors and, for walls, drained. Any condensation will be drained out of the wall assembly.

Table 9.25.1.2.
Ratio of Outboard to Inboard Thermal Resistance
Forming Part of Sentence 9.25.1.2.(1)

TABLE 5-1

Heating Degree Days of *Building Location*[1], Celsius degree-days	Minimum Ratio, Total Thermal Resistance Outboard of material's Inner Surface to Total Thermal Resistance Inboard of Material's Inner Surface
up to 4999	0.20
5000 to 5999	0.30
6000 to 6999	0.35
7000 to 7999	0.40
8000 to 8999	0.50
9000 to 9999	0.55
10000 to 10999	0.60
11000 to 11999	0.65
12000 or higher	0.75
Column 1	2

Note to Table 9.25.1.2.: (1) See Supplementary Standard SB-1.

Sentence 9.25.1.2.(3) provides an exception for wood-based panel-type sheathing materials that are not more than 12.5 mm thick. If these sheathing materials meet the material and thickness requirements of Article 9.23.16.2., and the related requirement of Article 9.23.16.5 for a minimum 2 mm gap, then the location of the sheathing with respect to the ratio of outboard to inboard thermal resistance does not need to be applied.

Sentences 9.25.1.2.(4) and (5) state that certain wall assemblies will require design to Part 5 depending on the location of the building and the indoor relative humidity that will be maintained during the heating season. The determination of this is based on the % indoor relative humidity, and the "mild climate indicator", which is given by a formula in Sentence 9.25.1.2.(6).

EXAMPLE QUESTION

For a particular location in Ontario the heating degree-day value yields a ratio of outboard to inboard thermal resistance of 0.50 when Table 9.25.1.2. is read. What does this tell us about the low permeance material in the building assembly

a) It has an RSI value of 0.50;
b) It is at a position 66.7% through the thermal resistance of the assembly; (from warm side)
c) Its air leakage characteristic value equals its permeance value for that location in Ontario;
d) It must be positioned outboard on an air space that is will drained.

ANSWER: The concept of ratio of outboard to inboard thermal resistance is used to ensure that low permeance material is not installed in a position in the building assembly where is would promote trapping and condensation of water vapour in the building assembly (causing insulation thermal breakdown and mould potential). The actual low permeance surface of the material must be warm enough to prevent vapour condensation under normal room conditions and outdoor conditions for the particular location in Ontario. In the Example Question we are told that there is twice as much thermal performance of the assembly is on the "cold side" of the material than on the "warm side" (ratio 1 to 2 or ½ = 0.50). Therefore the material is positioned 66.7% through the thermal resistance of the assembly (from warm side). The correct answer is b).

OBC Reference _____

EXERCISE #5-1

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. A summer cottage designed by an architect will be located in Bancroft, Ontario. It has been determined that the requirements of Section OBC 9.25 do not apply. This determination is based on what condition?
    a) Heating Degree Day value for location is less than 5000;
    b) Not intended for use on a continuing basis during the winter months;
    c) The design is being prepared and provided by an *architect;*
    d) The design will be reviewed by an *engineer.*

OBC Reference _____

2. A home is being designed for year round residence at the location of Atikokan, Ontario and utilizes wall sheathing with an air leakage characteristic of 0.09 $l/(s \bullet m^2)$ at 75Pa and water vapour permeance of 50 $ng/(Pa \bullet s \bullet m^2)$. What is the value of the Ratio of Outboard to Inboard Thermal Resistance given for this location and material condition?
    a) 0.20;
    b) 0.30;
    c) 0.40;
    d) 0.35.

OBC Reference _____

3. For the home described in question #2, the design is changed to use waferboard sheathing. What is the maximum thickness for the waferboard so that it need not comply with the air leakage and water permeance characteristics from Sentence 9.25.1.2.(1)?
    a) 9 mm;
    b) 12.5 mm;
    c) 15.9 mm;
    d) 19 mm.

OBC Reference _____

4. For the home described in question #2 is located in Dryden, Ontario. What is the mild climate indicator (MCI) for this location?
    a) 10,550;
    b) 10,950;
    c) 13,200;
    d) 12,800.

OBC Reference _____

5. For the home described in question #2, located in Dryden, the position of the low air- and vapour-permeance materials within the assembly relative to the thermal resistance elements will need to be designed to Part 5 if during the heating season:
    a) The indoor humidity will be maintained at 30%;
    b) The indoor humidity may reach 35%;
    c) The indoor humidity will be maintained at 40% and a humidifier will add moisture to maintain this level;
    d) The indoor humidity may reach 40% but the ventilation system will reduce the humidity to less than 35% when this occurs.

OBC Reference _____

THERMAL INSULATION

Required Insulation

All walls, ceilings and floors separating heated space from unheated space, the exterior air or the exterior soil are to be provided with sufficient thermal insulation to prevent moisture condensation on their room side during the winter and to ensure comfortable conditions for the occupants. Thermal insulation and thermal design will have a significant impact on the energy efficiency of the building.

Thermal insulation requirements are contained in Part 12 'Resource Conservation" of the OBC. Sentence 12.2.1.1.(3) states that the energy efficiency of a Part 9

residential building that is intended for occupancy during the winter months has three options to comply until January 1, 2012:

- Conform to the thermal insulation requirements of Subsection 12.3.2.,
- Conform to the thermal design requirements of Subsection 12.3.3., or
- Provide a rating or at least 80 when evaluated against the NRCan EnerGuide for new houses.

For the purposes of this module, we will examine only the thermal insulation requirements of Subsection 12.3.2. as a method of compliance.

Subsection 12.3.2. addresses thermal insulation for buildings of residential occupancy. Insulation is to be provided between heated and unheated spaces and between heated spaces and the exterior, and around the perimeter of concrete slabs-on-ground.

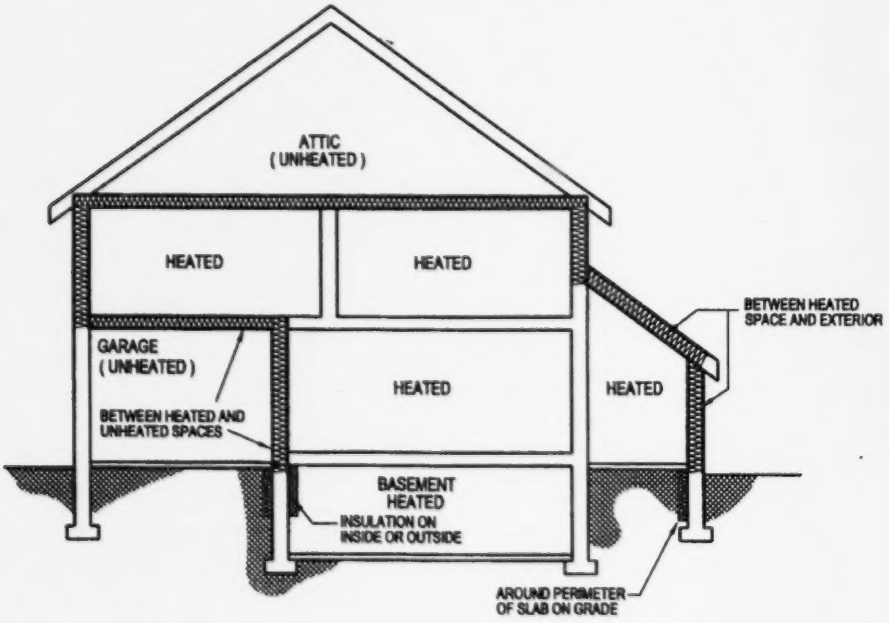


FIGURE 5-2

Reflective surfaces of insulating materials are to not be considered in calculating the thermal resistance of *building* assemblies.

With exceptions to follow, the minimum thermal resistance of insulation is to conform to Table 12.3.2.1.

Table 12.3.2.1.
Minimum Thermal Resistance of Insulation - Based on Degree Day Zones[1]
Forming Part of Sentence 12.3.2.1.(4)

TABLE 5-2

Building Element Exposed to the Exterior or to Unheated Space	RSI Value Required		
	Zone 1 Less than 5000	Zone 2 5000 or more	*Electric Space Heating* Zone 1 & 2
Ceiling below *attic or roof space*	7.00	7.00	8.80
Roof assembly without *attic or roof space*	4.93	4.93	4.93
Wall other than *foundation* wall	3.34	4.22	5.10
Foundation walls enclosing heated space	2.11	2.11	3.34
Floor, other than slab-on-ground	4.40	4.40	4.40
Slab-on ground containing heating pipes, tubes, ducts or cables	1.76	1.76	1.76
Slab-on-ground not containing heating pipes, tubes, ducts or cables	1.41	1.41	1.76
Basement floor slabs located more than 600 mm below grade	-	-	-
Column 1	2	3	4

Note to Table12.3.2.1.:
(1) Number of degree days for individual locations are contained in Supplementary Standard SB-1.

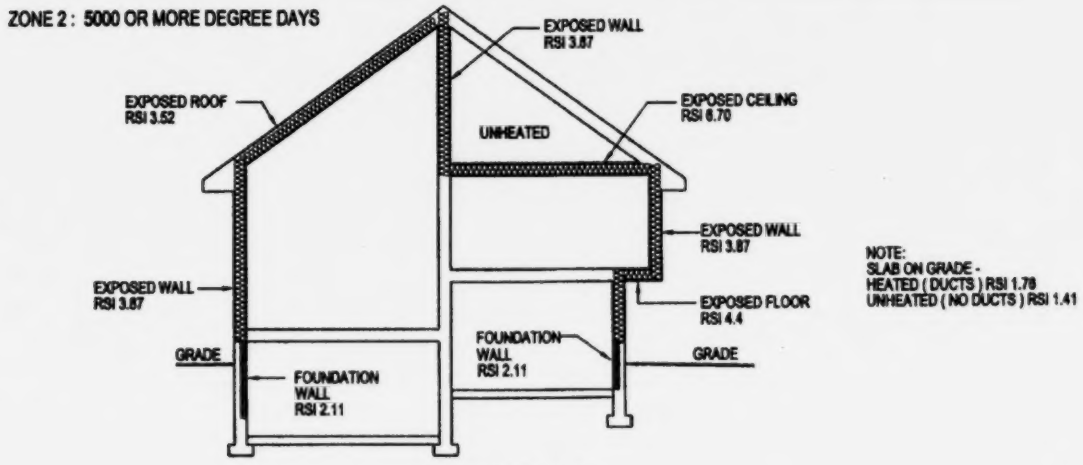


FIGURE 5-3

EXCEPTIONS TO TABLE 12.3.2.1.

Note that some exceptions to Table 12.3.2.1. apply differently when *electric space heating* is used in a *dwelling unit*.

Doors

Article 12.3.2.7. addresses the thermal resistance of doors. Except for doors on enclosed unheated vestibules and cold cellars, and except for glazed portions of doors, all doors separating heated space from unheated space are to have a thermal resistance of not less than RSI 0.7, where a storm door is not provided.

Glass Doors and Glazing

All sliding glass doors separating heated space from unheated space are to have an overall coefficient of heat transfer of not more than 2.0 W/ $m^{2}\cdot°C$, or an energy rating of not less than 17.

Article 12.3.2.6. states that all windows that separate heated space from unheated space are to have an overall coefficient of heat transfer of not more than 2.0 W/ $m^{2}\cdot°C$, or an energy rating of not less than 17 for openable windows and 27 for fixed windows.

Adjustment at Eaves

As per Article 12.3.2.3., the thermal resistance values in Table 12.3.2.1. for exposed roofs or ceilings may be reduced near eaves to the extent made necessary by the roof slope and required ventilation clearances, except that the thermal resistance of insulation at the location directly above the inner surface of the exterior wall is to be at least RSI 2.1.

Log Construction

Article 12.3.2.9. explains how thermal resistance is determined for log construction. Log wall construction and post, beam and plank construction is to have a minimum thermal resistance of RSI 2.1 for the total assembly. However, the total wall assembly may be reduced to not less than RSI 1.61 if the thermal resistance of insulation for the exposed roof or ceiling required in Table 12.3.2.1. is increased by an amount equivalent to the reduction permitted and for log walls, the logs have tongue-and-groove or splined joints.

Where milled log walls are installed, the thermal resistance value for the total wall assembly does not apply if the mean thickness of each log is not less than 150 mm, the thermal resistance of insulation for the exposed roof or ceiling required in Table 12.3.2.1. is increased by RSI 0.53, and the logs have tongue-and-groove or splined joints.

Enclosed Unheated Space

Article 12.3.2.5. states that where an enclosed unheated space is separated from a heated space by glazing, the unheated enclosure may be considered to provide a thermal resistance of 0.16 $m^{2\circ}C/W$.

Electric Space Heating

Doors and glazing for dwelling units using electric space heating are addressed under Article 12.3.2.8. When *electric space heating* is used in a *dwelling unit*, all sliding glass doors separating heated space from unheated space or the outdoors are to are to have - overall coefficient of heat transfer of not more than 1.6 W/ $m^{2\cdot\circ}C$, or an energy rating of not less than 25. Energy rating as determined in conformance with CAN/CSA-A440.2, "Energy Performance

Evaluation of Windows and Sliding Glass Doors".

When *electric space heating* is used in a *dwelling unit*, all glazing that separates heated space from unheated space or the outdoors are to have an overall coefficient of heat transfer of not more than 1.6 W/ m^{2}·°C, or an energy rating of not less than 25 for openable windows, and 35 for fixed windows. Energy rating as determined in conformance with CAN/CSA-A440.2, "Energy Performance Evaluation of Windows and Sliding Glass Doors".

Insulation Material Standards

Thermal insulation is to conform to accepted standards given in Article 9.25.2.2.. The OBC sometimes modifies the extent of conformance. In this case the *flame-spread ratings* requirements contained in the standards listed need not apply. Otherwise thermal insulation is to conform to the requirements of

- CAN/CGSB-51.25-M, "Thermal Insulation, Phenolic, Faced",
- CAN/CGSB-51-GP-27M, "Thermal Insulation, Polystyrene, Loose Fill",
- CAN/ULC-S701, "Thermal Insulation, Polystyrene, Boards and Pipe Covering",
- CAN/ULC-S702 "Mineral Fibre Thermal Insulation for Buildings",
- CAN/ULC-S703, "Cellulose Fibre Insulation (CFI) for Buildings",
- CAN/ULC-S704, "Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced",
- CAN/ULC-S705.1, "Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Material Specification", or
- CAN/ULC-S706, "Wood Fibre Thermal Insulation for Buildings".

Insulation in Contact with Ground or Moisture

Insulation in contact with the ground is to be inert to the action of *soil* and water and be such that its insulative properties are not significantly reduced by moisture.

Type 1 expanded polystyrene insulation as described in CAN/ULC-S701, "Thermal Insulation, Polystyrene, Boards and Pipe Covering" must not be used as roof insulation applied above the roofing membrane.

Installation of Thermal Insulation

The requirements for the installation of thermal insulation are in Article 9.25.2.3. Insulation is to be installed so that there is a reasonably uniform insulating value over the entire face of the insulated area. Insulation is to be applied to the full width and length of the space between furring or framing.

Contact with Low Air Permeance Element

Except where the insulation provides the principal resistance to air leakage, thermal insulation is to be installed so that at least one face is in full and continuous contact with an element with low air permeance (the *air-barrier system*).

Crawl Space – Insulation Arrangement

Insulation on the interior of *foundation* walls enclosing a crawl space is to be applied so that there is not less than a 50 mm clearance above the crawl space floor if the insulation is of a type that may be damaged by water.

Insulation Around Slabs-on-Ground

Insulation around concrete slabs-on-ground is to be located so that heat from the *building* is not restricted from reaching the ground beneath the perimeter, where exterior walls are not supported by footings extending below frost level.

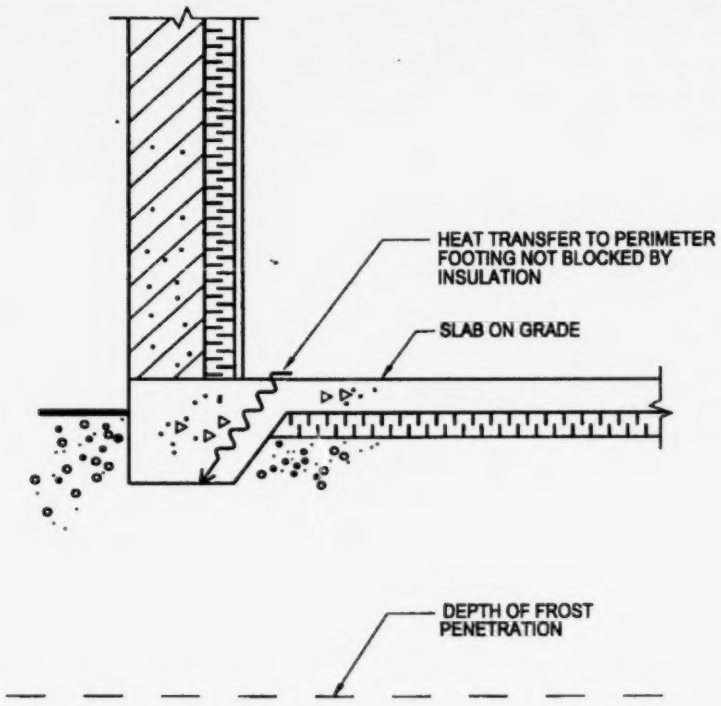


FIGURE 5-4

Weather and Mechanical Protection – Exterior

Where insulation is exposed to the weather and subject to mechanical damage, it is to be protected with not less than

- 6 mm asbestos-cement board,
- 6 mm preservative-treated plywood, or
- 12 mm cement parging on wire lath applied to the exposed face and edge.

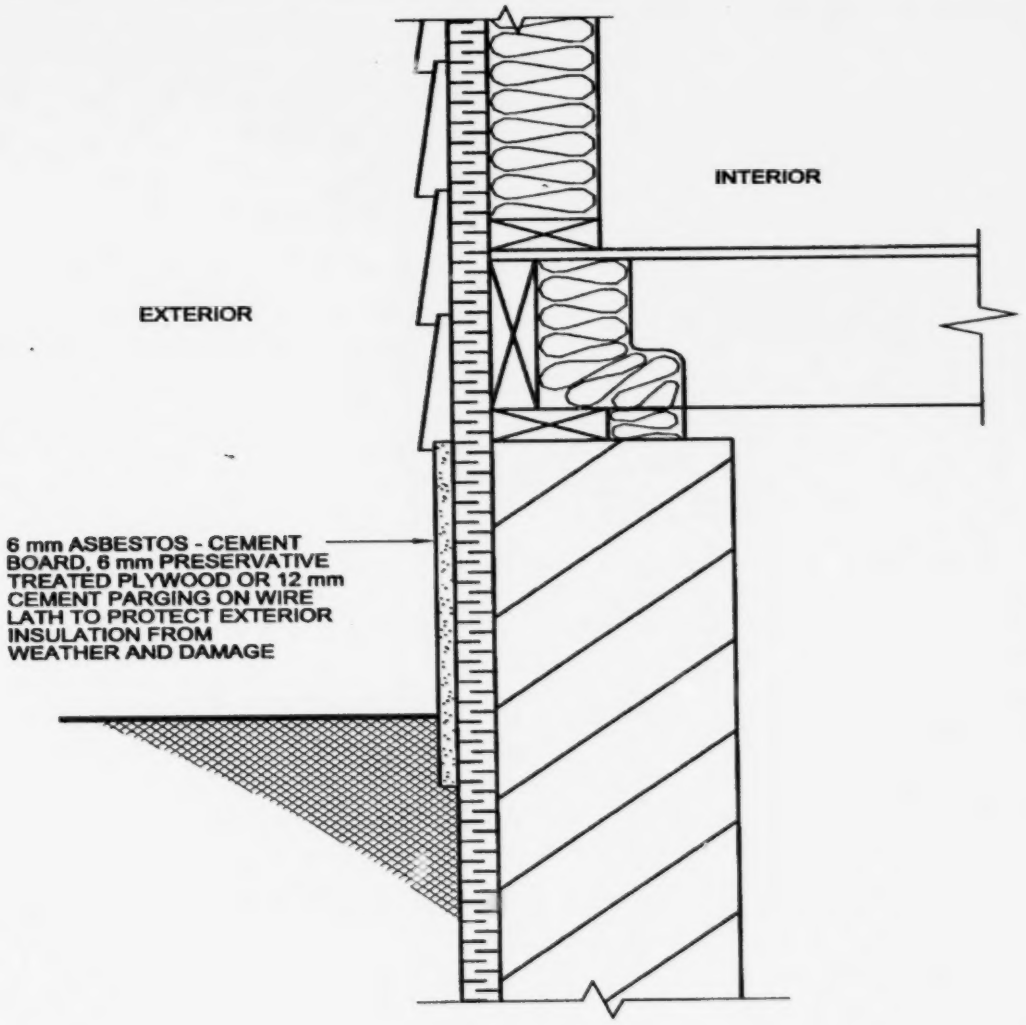


FIGURE 5-5

Mechanical Protection – Interior

Insulation and vapour barrier are to be protected from mechanical damage by a covering of gypsum board, plywood, particleboard, OSB, waferboard or hardboard. However in unfinished *basements*, this protection need not be provided for mineral fibre insulation provided it is covered with polyethylene vapour barrier of at least 0.15 mm in thickness.

INSULATION MOVEMENT IN FACTORY-BUILT BUILDINGS

Insulation in factory-built *buildings* is to be installed so that it will not become dislodged during transportation.

FOUNDATION WALLS – INSULATION SYSTEMS

Article 12.3.2.4. sets out the requirements for insulation of foundation walls. *Foundation* walls enclosing heated space shall be insulated from the underside of the subfloor to not less than 600 mm below the adjacent exterior ground level (for building permit that has been applied for before January 1, 2009).

Foundation walls enclosing heated space shall be insulated from the underside of the subfloor to not more than 380 mm above the finished floor level of the *basement* (for building permit that has been applied after December 31, 2008). However this insulation may be provided by a system installed

- on the interior of the *foundation* wall,
- on the exterior face of the *foundation* wall, or
- partially on the interior and partially on the exterior, provided the combined thermal performance of the system is equivalent to a permitted interior or exterior system.

The gap between the floor slab and the insulation is permitted to be a maximum of 150 mm. The insulation is permitted to be extended towards the floor which would result in a smaller gap. The intention is to protect the insulation from water that may accumulate at the bottom.

Hollow Masonry Units – Insulation and Air Sealing

If a *foundation* wall is constructed of hollow masonry units, one or more of the following is to be used to control convection currents in the core spaces

- filling the core spaces,
- at least one row of semi-solid blocks at or below *grade*, or

- other similar methods.

Masonry walls of hollow units which penetrate the ceiling are to be sealed at or near the ceiling adjacent to the roof space to prevent air within the voids from entering the *attic or roof space* by

- capping with masonry units without voids, or
- installation of flashing material extending across the full width of the masonry.

Installation of Loose-Fill Insulation

Loose-fill insulation is governed by Article 9.25.2.4. Loose-fill insulation is generally used on horizontal surfaces only. However there are a number of exceptions

- Loose-fill insulation is permitted in an unconfined space such as an attic space over a sloped ceiling, if the supporting slope is not be more than 4.5 in 12 for mineral fibre or cellulose fibre insulation, and 2.5 in 12 for other types of insulation.
- Loose-fill insulation may be used in wood-frame walls of existing *buildings*.
- Where blown-in insulation is installed in above-ground or in below-ground wood frame walls of new *buildings*, there are a number of conditions:
  - the density of the installed insulation shall be sufficient to preclude settlement,
  - the insulation shall be installed behind a membrane that will permit visual inspection prior to installation of the interior finish,
  - the insulation shall be installed in a manner that will not interfere with the installation of the interior finish, and
  - no water shall be added to the insulation, unless it can be shown that the added water will not adversely affect other materials in the assembly.
- Water repellent loose-fill insulation may be used between the outer and inner wythes of masonry cavity walls.

SOFFIT VENTING

Where soffit venting is used, measures are to be taken

- to prevent loose-fill insulation from blocking the soffit vents and to maintain an open path for circulation of air from the vents into the *attic or roof space*, and
- to minimize air flow into the loose-fill insulation near the soffit vents to maintain the thermal performance of the material.

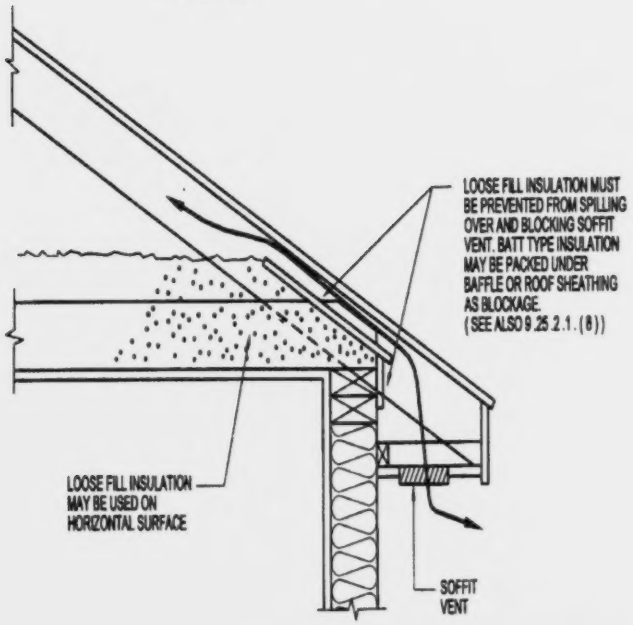


FIGURE 5-6

INSTALLATION OF SPRAY-APPLIED POLYURETHANE

Spray-applied polyurethane insulation is to be installed in accordance with CAN/ULC-S705.2, "Thermal Insulation – Spray-Applied Rigid Polyurethane Foam, Medium Density, Installer's Responsibilities - Specification".

EXAMPLE QUESTION

A home occupied year-round has a basement and a single *storey* with cathedral ceilings. It is equipped with electric baseboard heaters and has two air circulation fans hanging from cathedral ceilings. What is the minimum thermal resistance of roof insulation?

a) RSI 8.80;
b) RSI 7.00;
c) RSI 4.93;
d) RSI 3.34.

Table 12.3.2.1.
Minimum Thermal Resistance of Insulation - Based on Degree Day Zones(1)
Forming Part of Sentence 12.3.2.1.(4)

TABLE 5-3

Building Element Exposed to the Exterior or to Unheated Space	RSI Value Required		
	Zone 1 Less than 5000	Zone 2 5000 or more	*Electric Space Heating* Zone 1 & 2
Ceiling below *attic or roof space*	7.00	7.00	8.80
Roof assembly without *attic or roof space*	4.93	4.93	4.93
Wall other than *foundation* wall	3.34	4.22	5.10
Foundation walls enclosing heated space	2.11	2.11	3.34
Floor, other than slab-on-ground	4.40	4.40	4.40
Slab-on ground containing heating pipes, tubes, ducts or cables	1.76	1.76	1.76
Slab-on-ground not containing heating pipes, tubes, ducts or cables	1.41	1.41	1.76
Basement floor slabs located more than 600 mm below grade	-	-	-
Column 1	2	3	4

Note to Table12.3.2.1.:
(1) Number of degree days for individual locations are contained in Supplementary Standard SB-1.

ANSWER: Because the *dwelling unit* has electric space heating its location degree-day value is not required – enter the table vertically in column 1. Cathedral ceilings is a style of construction that typically does not have an *attic* or *roof space* so enter the table horizontally at "Roof assembly . . . " At the intersection of the two entry points is the cell containing the correct data for this application. The correct answer is c).

OBC Reference _____

EXERCISE #5-2

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. A year round residence is planned for a location in Arnprior, Ontario. A forced-air electric furnace will heat the home. What is the minimum thermal resistance of insulation required to be installed in the walls?
    a) RSI 5.10;
    b) RSI 4.22;
    c) RSI 3.34;
    d) RSI 2.11.

OBC Reference _____

2. A year round residence is planned for a location in Big Trout Lake, Ontario. The house will be of log wall construction and be equipped with electric space heating. What is the minimum thermal resistance value required for the wall construction?
    a) RSI 4.70;
    b) RSI 3.87;
    c) RSI 3.00;
    d) RSI 2.10.

OBC Reference _____

3. A year round residence has an electrically heated crawl space that is insulated with a non-water resistant insulation with a thermal resistance value of 3.25. The crawlspace floor is 650mm (25-1/2 in) below the adjacent exterior ground level. What distance above the crawl space floor is the insulation required to terminate?
    a) 600mm;
    b) 50mm;
    c) 12mm;
    d) 0mm.

OBC Reference _____

4. Under which one of the following conditions does the Code allow the use of non-water repellent loose-fill insulation on non-horizontal surfaces?
    a) in a newly constructed wood frame house;
    b) in an attic space sloped at 4.5 in 12 for mineral fibre insulation;
    c) between the outer and inner wythes of masonry cavity walls;
    d) in masonry walls of hollow units.

OBC Reference _____

AIR BARRIER SYSTEMS

Required Barrier to Air Leakage

Article 9.25.3.1. requires air barrier systems. Thermally insulated wall, ceiling and floor assemblies are to be constructed so as to include an *air barrier system* which will provide a continuous barrier to air leakage

- from the interior of the *building* into wall, floor, *attic or roof spaces* sufficient to prevent excessive moisture condensation in such spaces during the winter, and
- from the exterior inward sufficient to prevent moisture condensation on the room side during winter.

Air Barrier System Properties

Article 9.25.3.2. sets out air barrier system properties. Sheet and panel type materials intended to provide the principal resistance to air leakage are to have an air leakage characteristic not greater than 0.02 L/(s•m^2) measured at an air pressure differential of 75 Pa.

Polyethylene sheet used to provide the air-tightness in the *air barrier system* is to conform to CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet for Use in Building Construction".

Continuity of the Air Barrier System

The requirements for continuity of the air barrier system are given in Article 9.25.3.3. Where the *air barrier system* consists of an air-low permeance panel-type material, all joints are to be sealed to prevent air leakage.

Where the *air barrier system* consists of flexible sheet material, all joints are to be sealed or lapped not less than 100 mm and clamped, such as between framing members, furring or blocking and rigid panels.

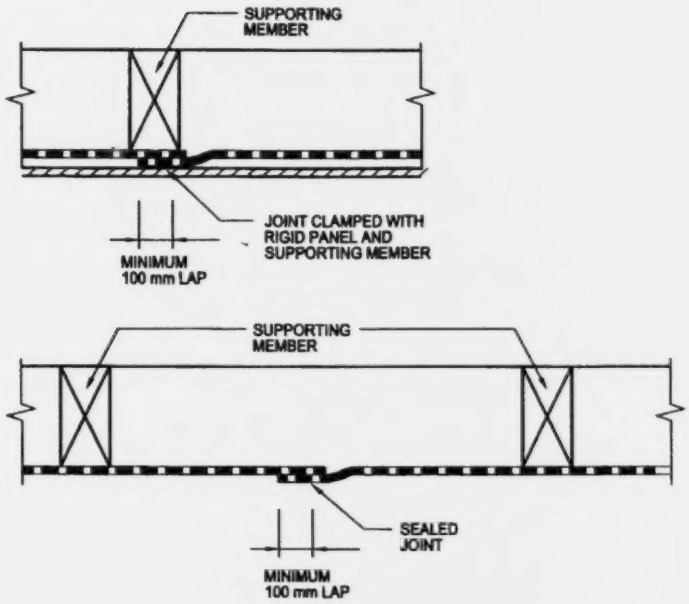


FIGURE 5-7

At Meeting of Construction Elements

Where an interior wall meets an exterior wall, ceiling, floor or roof to be provided with an air barrier protection, the *air barrier system* is to extend across the intersection.

Where an interior wall projects through a ceiling or extends to become an exterior wall, spaces in the wall are to be blocked to provide continuity across those spaces with the *air barrier system* in the abutting walls or ceiling.

Where an interior floor projects through an exterior wall or extends to become an exterior floor, continuity of the *air barrier system* is to be maintained from the abutting walls across the floor assembly.

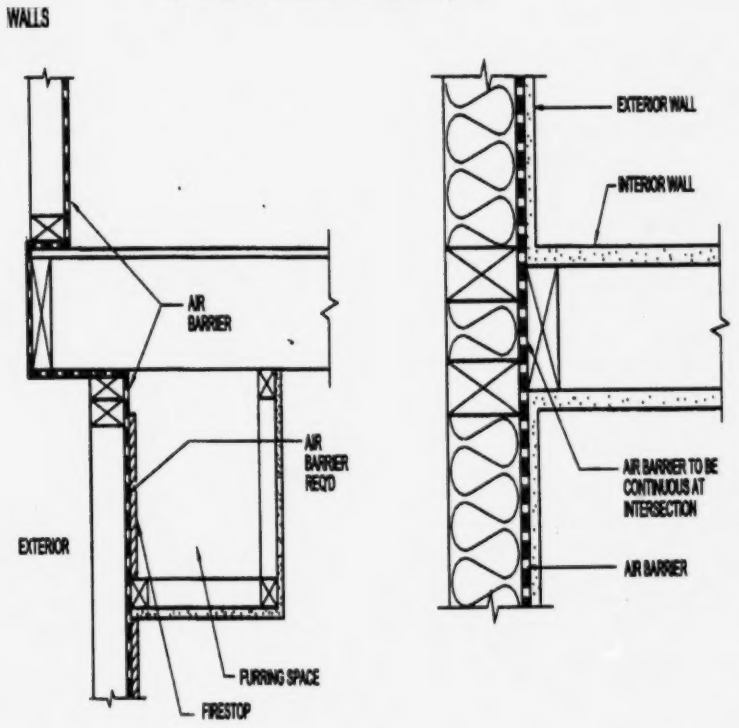


FIGURE 5-8

BUILDING SERVICES PENETRATIONS AND REQUIRED CLEARANCES

Penetrations of the *air barrier system*, such as those created by the installation of doors, windows, electrical wiring, electrical boxes, piping or ductwork, are to be sealed to maintain the integrity of the *air barrier system* over the entire surface.

Access hatches installed through assemblies constructed with an *air barrier system* are to be weather-stripped around their perimeters to prevent air leakage.

Clearances between *chimneys* or *gas vents* and the surrounding construction that would permit air leakage from

within the building into a wall or attic or roof space are to be sealed by *noncombustible* material to prevent leakage.

EXAMPLE QUESTION

What is one fundamental characteristic of an *air barrier system*?

a) Ensures occupants receive enough fresh air;
b) It is sealed by *noncombustible* material;
c) Provides a continuous barrier to air leakage;
d) Most joints are sealed to prevent air leakage.

OBC Reference _____

EXERCISE #5-3

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. In what season are air barriers most important in preventing moisture condensation?
   a) Summer;
   b) Spring;
   c) Winter;
   d) Fall.

OBC Reference _____

2. The principal resistance to air leakage is to be provided by sheet type material. Which one of the following values for air leakage characteristic measured at an air pressure differential of 75Pa would be permitted by the Code?
   a) 0.021 l/(s•m^2);
   b) 0.200 l/(s•m^2);
   c) 0.019 l/(s•m^2);
   d) 0.750 l/(s•m^2).

OBC Reference _____

3. Where an interior wall meets and exterior wall required to be provided with an air barrier protection. How must the air barrier system be installed?
    a) Across the intersection;
    b) Lapped not less that 100mm at the intersection;
    c) Clamped by furring or blocking;
    d) Sealed by a non-combustible material.

OBC Reference _____

4. A *gas vent* in a home is installed in a vertical shaft from the ceiling of the basement through the first floor, first floor ceiling, second floor, second floor ceiling, attic space, and finished roof. Which of the following combinations of sealing material and sealing location is required by the code?
    a) *Non-combustible* material at the bottom of the vertical shaft in the basement;
    b) Weatherstrip material at the second floor ceiling;
    c) 100mm lapping material at the finished roof;
    d) *Non-combustible* material at the second floor ceiling.

OBC Reference _____

VAPOUR BARRIERS

Required Barrier to Vapour Diffusion

As per Article 9.25.4.1., thermally insulated wall, ceiling and floor assemblies are to be constructed with a vapour barrier sufficient to prevent condensation in wall spaces, floor spaces, and *attic or roof spaces*.

Vapour Barrier Materials

Article 9.25.4.2. states the required properties of vapour barrier materials. The basic requirement is that *vapour barriers* are to have a permeance not greater than 60 ng/(Pa·s·m^2), measured in accordance with ASTM E96,

"Water Vapor Transmission of Materials"

Depending on the indoor humidity conditions and the location of the building, the *vapour barrier* may require design under Part 5. The "mild climate indicator" is used in this assessment (this was seen previously when determining the position of low air- and vapour-permeance materials in Article 9.25.1.2.). If the indoor humidity is will be high (by design or by conditions of use), and HVAC systems are not installed to reduce the relative humidity, then design under Part 5 will be required.

Polyethylene

Where polyethylene is installed as a high resistance *vapour barrier* it is to conform to CAN/CGSB-51.34-M, "Vapour Barrier, Polyethylene Sheet for Use in Building Construction".

Other Than Polyethylene

Membrane-type *vapour barriers* other than polyethylene are to conform to CAN/CSA-51.33-M, "Vapour Barrier, Sheet, and Excluding Polyethylene, for Use in Building Construction".

Coatings

Where a coating is applied to gypsum board to function as the *vapour barrier*, the permeance of the coating is to be determined in accordance with CAN/CGSB-1.501-M, "Method for Permeance of Coated Wallboard".

Installation of Vapour Barriers

Article 9.25.4.3. addresses the installation of vapour barriers. *Vapour barriers* are to be installed to protect the entire surfaces of thermally insulated wall, ceiling and floor assemblies.

Vapour barriers are to be installed sufficiently close to the warm side of insulation to prevent condensation at design conditions.

EXAMPLE QUESTION

Which of the following materials is **NOT** a vapour barrier material?

a) Polyethylene sheet;
b) Vapour retardant paint;
c) Vapour barrier sheet, excluding polyethylene;
d) Exterior wall parging material.

ANSWER: To be effective, a vapour barrier must have a position in the assembly close enough to the "warm side" to prevent condensation at design conditions. Wall parging material is placed on exterior surfaces of wall assemblies. The correct answer is d).

OBC Reference _____

EXERCISE #5-4

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. What is the primary purpose of a *vapour barrier* system?
   a) Prevent condensation due to air leakage;
   b) Prevent condensation due to water vapour diffusion in wall, floor, *attic* or *roof spaces;*
   c) Replace air barrier systems;
   d) Close penetrations.

OBC Reference _____

2. When choosing a vapour barrier for the wall design which one of the following vapour barrier permeance values meet the requirements of the Code?
   a) 45 ng/(Pa·s·m^2);
   b) 65 ng/(Pa·s·m^2);
   c) 70 ng/(Pa·s·m^2);
   d) 80 ng/(Pa·s·m^2).

OBC Reference _____

3. Which one of the following best describes the required location of the vapour barrier system?
    a) Warm side of insulation, prevent condensation;
    b) Cold side of the insulation to block air leakage;
    c) Outboard of the attic insulation;
    d) Extending across the wall intersections.

OBC Reference _____

4. Which of the following buildings in Ottawa will require a vapour barrier system designed in accordance with Part 5?

    a) A house where daily showers raise the indoor relative humidity to 70% for a 2 hour period in the mornings;
    b) A year-round greenhouse with an indoor relative humidity of 80%;
    c) A house with a large solarium addition where the owner will install a HVAC system to maintain the relative humidity below 35%;
    d) A house with a large solarium addition where the owner will install a HVAC system to maintain the relative humidity above 35%;.

OBC Reference _____

Ontario

Ministry of Municipal Affairs and Housing

HVAC-HOUSE

PARTICIPANT'S MODULE #6

Ventilation – Part 9 Requirements

May 2008

INTRODUCTION

This module covers the core concept of ventilation in a *building*. Natural ventilation in *residential occupancies* and mechanical ventilation serving one *dwelling unit* is the major focus. Requirements for ventilation area, exhaust, intake, equipment, ducting, arrangement, and design are all examined.

OBJECTIVES

Upon completion of this module, participants will:

- Determine applicable *building* classifications and room and space types for OBC ventilation measures;
- Calculate natural ventilation requirements for buildings of *residential occupancies*;
- Know and understand the requirements for mechanical ventilation for single *dwelling units*;
- Calculate the requirements for mechanical ventilation;
- Determine the requirements for ducts, heat recovery ventilators, and their installation;
- Identify the requirements for outdoor intake and exhaust openings.

NATURAL AND MECHANCIAL VENTILATION - OBC PART 9

This module covers the ventilation of rooms and spaces in *residential occupancies* by natural ventilation (OBC Part 9).

This module also covers self-contained mechanical ventilation systems serving only one *dwelling unit* (OBC Part 9).

Exclusions

- Natural ventilation of rooms and spaces in other than *residential occupancies* is to conform to OBC Part 6 and is not covered in this module.
- Mechanical ventilation systems, other than self-contained systems serving single *dwelling units* are to conform to OBC Part 6 and are not covered in this

module. Complying with Part 6 of the OBC refers to following good engineering practice and using appropriate duct material that are indicated in the manufacturer's installation instructions.

- *Storage garages* for more than 5 cars, are to be ventilated in accordance with Part 6 of the OBC
- A clothes dryer exhaust duct system is to conform with Part 6 of the OBC.
- As per Article 9.18.3.1., where unheated crawl spaces in Part 9 buildings are ventilated by natural means, ventilation is to be provided with not less than 0.1 m^2 of unobstructed uniformly distributed vent area for every 50 m^2 of *floor area* (designed to prevent the entry of snow, rain and insects).

Natural Ventilation Area for Rooms and Spaces

Subsection 9.32.2. addresses natural ventilation. The unobstructed openable ventilation area to the outdoors for rooms and spaces in residential *buildings* ventilated by natural means is to conform to Table 9.32.2.1.

Table 9.32.2.1.
Natural Ventilation
Forming Part of Sentence 9.32.2.1.(1)

TABLE 6-1

Location		Minimum Unobstructed Area
Within *dwelling unit*	Bathrooms or water closet rooms	0.09 m^2
	Unfinished *basement* space	0.2 per cent of the floor area
	Dining rooms, living rooms, bedrooms, kitchens, combined rooms, dens, recreation rooms and all other finished rooms	0.28 m^2 per room or combination of rooms
Other than within *dwelling unit*	Bathrooms or water closet rooms	0.09 m^2 per water closet
	Sleeping areas	0.14 m^2 per occupant
	Laundry rooms, kitchens, recreation rooms	4 per cent of the floor area
	Corridors, storage rooms and other similar public rooms or spaces	2 per cent of the floor area
	Unfinished *basement* space not used on a shared basis	0.2 per cent of the floor area
Column 1	2	3

Where a vestibule opens directly off a living or dining room within a *dwelling unit*, ventilation to the outdoors for such rooms may be through the vestibule.

As per Article 9.32.1.3., where a room or space is not provided with natural ventilation area, mechanical ventilation is to be provided to exhaust inside air from or to introduce outside air to that room or space at the rate of

- one-half air change per hour if the room or space is mechanically cooled in summer, and
- one air change per hour if it is not.

Note that other requirements of the OBC may dictate openable windows are required for rooms or spaces, example; bedroom areas.

Protection from Weather and Insects

Openings for natural ventilation other than windows are to be constructed to provide protection from the weather and insects. Screening is to be of rust-proof material.

EXAMPLE QUESTION

This module covers OBC Section 9.32 Ventilation. Which one of the following represents a summary of the scope of 9.32?

a) House ventilation;
b) Natural ventilation and mechanical ventilation of rooms and spaces in *residential occupancies;* (Part 9 *buildings)*
c) Rooms and spaces in *residential occupancies* by natural ventilation and mechanical ventilation serving only one *dwelling unit;* (Part 9 *buildings)*
d) Natural ventilation of rooms and spaces in other than *residential occupancies* and mechanical ventilation of *dwelling units.*

OBC Reference _____

EXERCISE #6-1

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. A single-family house is air-conditioned (mechanically cooled) and has a basement that contains three finished rooms of 10 m^2 each and unfinished *basement* space of 14 m^2. What is the minimum unobstructed area required for natural ventilation of the unfinished *basement* space?
   a) 0.028 m^2;
   b) 0.020 m^2;
   c) 0.030 m^2;
   d) 0.014 m^2.

OBC Reference _____

2. The house in Question #1 provides mechanical ventilation instead of natural ventilation for the finished *basement* space. Assuming that the finished ceiling height in the basement is 2.5 m, what is the minimum required mechanical ventilation airflow rate in m^3 per hour for each finished room?
   a) 25.0;
   b) 0.50;
   c) 12.5;
   d) 1.00.

OBC Reference _____

3. Which one of the following is NOT a 9.32.2 requirement or allowance for natural ventilation in *residential occupancies*?
   a) Rust-proof screen material;
   b) Where natural ventilation is not provided, mechanical ventilation must be provided;
   c) Natural ventilation allowed through vestibules;
   d) Screens on windows.

OBC Reference _____

4. A single-family home is not air-conditioned and has a living room with fixed windows. The room area is 18 m^2. Assuming a 2.5 m ceiling height, what is the required minimum mechanical ventilation airflow rate in m^3/min?
    a) 1.5;
    b) 0.75;
    c) 3.0;
    d) 0.38.

OBC Reference _____

MECHANICAL VENTILATION FOR DWELLING UNITS

Every *dwelling unit* that is supplied with electrical power is to be provided with a mechanical ventilation system in accordance with Subsection 9.32.3.

Fuel-fired Appliance and Dwelling Unit Catorgization

A non-solid fuel-fired *appliance* is classified as

- direct vented; if the combustion air is supplied directly from the outdoors to the combustion chamber via a sealed passageway, and the products of combustion are exhausted directly outdoors through an independent sealed vent,
- mechanically vented induced draft; if the combustion air is supplied from within the *building* envelope and the products of combustion are positively conveyed to the outdoors by means of a dedicated sealed vent, or
- natural draft; if combustion air is supplied from within the *building* envelope and the products of combustion are conveyed to the outdoors through a *chimney* or Type B vent.

A *dwelling unit* is to be categorized as;

Type I

When all fuel-fired combustion *appliances* located in the *dwelling unit* are

- direct vented (direct vented non-solid fuel-fired fireplaces allowed) or are
- mechanically vented induced draft (excluding mechanically vented induced draft non-solid fuel-fired fireplaces), and
- the *dwelling unit* does not contain a solid fuel-fired combustion *appliance* or fireplace.

Type II

When a solid fuel-fired combustion *appliance* is installed in a Type I *dwelling unit*,

Type III

When a mechanically vented induced draft non-solid fuel-fired fireplace or a natural draft *appliance* or fireplace is present, or

Type IV

When *electric space heating* is present.

Required Mechanical Ventilation

The required mechanical ventilation system for each *dwelling unit* Type is to conform to

- Part 6 OBC for all Types of dwelling units, or optionally
- Part 9 OBC for Type I, Type II or Type IV *dwelling unit*.

Seasonal Recreational Buildings

The OBC provides exclusions for *buildings* (9.36.2.1.) used or intended to be used as seasonal recreational *buildings*, in particular to this module, mechanical ventilation need not be provided (Sentence 9.36.2.1.(3)). However, where mechanical ventilation is provided in the *building*, it is to comply with the related requirements of Part 9 OBC.

Total Ventilation Capacity

The minimum total ventilation capacity of the ventilation system required is to be the sum of the individual room capacities given in Table 9.32.3.3.

Table 9.32.3.3.
Ventilation Capacity
Forming Part of Sentence 9.32.3.3.(1)

TABLE 6-2

Room	Capacity, L/s
Master bedroom[1]	10
Other bedrooms	5
Living room[2]	5
Dining room[2]	5
Kitchen	5
Family Room[2]	5
Recreation room	5
Basement[3]	10
Other habitable rooms[4]	5
Bathroom or water closet room	5
Laundry room	5
Utility room	5
Column 1	2

Notes to Table 9.32.3.3.:
[1] At least one bedroom in each *dwelling unit* is to be designated as the master bedroom.
[2] Ventilation capacities assigned to any combined living/dining or family/dining space is to be determined as if the spaces were individual rooms.
[3] Where a *basement* incorporates rooms of the types designated in this Table, the assigned ventilation capacities for each room is to be as specified for those types of rooms. *Basement* areas used for other purposes that exceed 2/3 of the total *basement* floor area are to be assigned a fan capacity of 10 L/s. Those that are less than 2/3 of the total floor area are to be assigned 5 L/s.
[4] Other habitable rooms are to be assigned a ventilation capacity of 5 L/s. This does not include spaces intended solely for access, egress, storage or service equipment.

Clarification to Table 9.32.3.3 notes include

- combined rooms are assigned ventilation capacities as if they were separate spaces
- listed room types located in basements are assigned their listed capacities
- generally, basements with any habitable rooms will be assigned a total ventilation capacity greater than the listed value for basements alone
- non-listed habitable rooms do not include spaces intended solely for access, egress, storage, or service equipment

EXAMPLE QUESTION

A non-solid fuel-fired *appliance* is supplied with combustion air from within the *building* envelope and its products of combustion are positively conveyed to the outdoors by means of a dedicated sealed vent. It would be classified as?

a) Direct vented;
b) Natural draft;
c) Type II;
d) Mechanically vented induced draft.

OBC Reference _____

EXERCISE #6-2

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. Which one of the following would NOT be present in a Type I *dwelling unit*?
   a) Mechanically vented induced draft combustion *appliance;*
   b) Direct vented non-solid fuel-fired fireplace;
   c) Direct vented combustion *appliance;*
   d) Mechanically vented induced draft non-solid fuel-fired fireplace.

OBC Reference _____

2. Which *dwelling unit* "Type" does not have an option of conformance with Subsection 9.32.3 Mechanical Ventilation?
   a) Type I;
   b) Type III;
   c) Type IV;
   d) Type II.

OBC Reference _____

3. A *dwelling unit* contains;
   a combination living/dining room,
   a kitchen,
   a family room,
   a master bedroom,
   a washroom,
   two other bedrooms,
   a ski storage room,
   a laundry room
   and a basement,

   What is the minimum total ventilation capacity (in L/s) of the ventilation system according to Table 9.32.3.3.?
   a) 50;
   b) 60;
   c) 55;
   d) 70.

OBC Reference _____

4. Which one of the following would be considered a habitable room?
   a) Service equipment room;
   b) Sewing room;
   c) Main entrance vestibule;
   d) Walk-in pantry.

OBC Reference _____

PRINCIPAL EXHAUST

Article 9.32.3.4. sets out the requirements for the capacity and installation of a principal exhaust fan. A principal exhaust fan is to be installed and is to be rated to provide not less than the capacity given in Table 9.32.3.4.A.

Table 9.32.3.4.A.
Principal Exhaust Fan Capacity
Forming Part of Sentence 9.32.3.4.(1)

TABLE 6-3

Number of Bedrooms in *Dwelling Unit*	Capacity, L/s
1	15
2	22.5
3	30
4	37.5
More than 4	Part 6 design
Column 1	2

Principal Exhaust Control and Capacity Adjustment

The principal exhaust fan is to be controlled by a manual switch, centrally located in the *dwelling unit* and to be identified with the words VENTILATION FAN.

Where the installed capacity of the principal exhaust fan exceeds the minimum capacity required by more than 50%, the fan control manual switch is to include provision to allow reduction of the flow to within ±10% of the minimum capacity required

A principal exhaust fan may be controlled by a dehumidistat or other automatic control device where the required manual switch is capable of activating the fan regardless of the setting of the automatic control.

The principal exhaust may be provided by means of a heat recovery ventilator installed in accordance with Part 9 OBC.

Principal Exhaust Fan Intake Location

Where an exhaust air intake for the principal exhaust fan is connected directly to the duct system of a forced air heating system or other central air circulating system, it is to

- be connected to the return air side of the system, and
- be connected not less than 1 000 mm upstream from any outdoor air supply duct.

Where an exhaust air intake for the principal exhaust fan is located in the kitchen, it is to be located in the ceiling or on the wall within 300 mm of the ceiling.

Principal Exhaust Duct Sizing

Single or multiple *exhaust ducts* serving the principal exhaust fan required by Sentence are to be sized according to Part 6 OBC except that they may be sized according to Table 9.32.3.4.B. where

- the longest total duct length, from intake grille to outdoor hood, does not exceed 12 m, and
- the number of elbows does not exceed 4,
- and, in any case, the duct must not to be smaller than recommended by the manufacturer of the fan.

Table 9.32.3.4.B.
Principal Exhaust Duct Size
Forming Part of Sentence 9.32.3.4.(9)

TABLE 6-4

Number of Bedrooms in *Dwelling Unit*	Minimum *Exhaust Duct* Diameter			
	Ducts Connected to Inlet and Outlet of Principal Exhaust Fan		Ducts Connected to One Side Only of Principal Exhaust Fan	
	Smooth Duct, Mm	Flexible Duct, Mm	Smooth Duct, Mm	Flexible Duct, mm
1	100	125	100	125
2	125	150	125	150
3	125	150	150	175
4	150	175	150	175
More than 4	Part 6 Design	Part 6 Design	Part 6 Design	Part 6 Design
Column 1	2	3	4	5

In applying Table 9.32.3.4.B.

- where there is more than one exhaust air inlet duct connected directly to the fan, the diameter of the inlet ducts may be decreased by 25 mm, and
- where the *exhaust duct* is connected to the duct system of a forced air heating system, the duct diameter is to be increased by 25 mm.

EXAMPLE QUESTION

A single family home has a second floor with three bedrooms and a partially finished *basement* with one bedroom. What is the minimum capacity for a required principal exhaust fan?

a) 30;
b) 22.5;
c) 37.5;
d) Determined by Part 6 design.

OBC Reference _____

EXERCISE #6-3

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. A principal exhaust fan may be controlled by a dehumidistat or other automatic control device. Which one of the following operational characteristic is required by the OBC?
   a) Maintains humidity to +/- 10% ;
   b) Manual switch is capable of activating the fan regardless of the state of the automatic control;
   c) 100% capacity control is available;
   d) Automatic shut-off with timer.

OBC Reference _____

2. Which one of the following is a requirement of the OBC when an exhaust air intake for the principal exhaust fan is connected directly to the duct system of a forced air heating system or other central air circulating system?
   a) Connected to the supply side of the system;
   b) Connected not more than 1 000 mm upstream from any outdoor air supply duct;
   c) Located in the ceiling or on the wall within 300 mm of the ceiling;
   d) Connected not less than 1 000 mm upstream from any outdoor air supply duct.

OBC Reference _____

3. For the purpose of Article 9.32.3.4. Principal Exhaust, a principal exhaust system has two ducts connected to the inlet side of the principal exhaust fan (ducts connected to one side only). If the system is installed in a *dwelling unit* with two bedrooms, what is the minimum *exhaust duct* diameter (in mm) if flexible ducts are used?
    a) 150;
    b) 125;
    c) 175;
    d) 100.

OBC Reference _____

4. For the system arrangement described in Question # 3 the *exhaust duct* is connected to the duct system of a forced air heating system. What adjustment to the duct diameter (in mm) is required?
    a) Decrease by 25;
    b) Increase by 12;
    c) Increase by 25;
    d) No adjustment required.

OBC Reference _____

SUPPLEMENTAL EXHAUST

Article 9.32.3.5. sets out the requirements for supplemental exhaust. Additional supplemental exhaust capacity is to be installed as necessary so that the total capacity of all kitchen, bathroom, water closet room and other supplemental exhaust air intakes is not less than the total ventilation capacity, as calculated from Table 9.32.3.3., minus the principal exhaust fan capacity, as calculated from Table 9.32.3.4.A.

Simple heat recovery ventilator connections (supply and exhaust from the return air duct) may provide total ventilation capacity, but this does not exempt exhaust fan requirements from each bathroom and kitchen. If a heat recovery ventilator serves a washroom, an additional exhaust fan is not required.

Supplemental Exhaust Fan Intake Location

An exhaust air intake is to be installed in each kitchen, bathroom and water closet room.

Where the intake for a supplemental exhaust fan other than a range hood or range-top fan is installed in a kitchen, it is to be installed in the ceiling or on the wall within 300 mm of the ceiling.

Supplemental Exhaust Duct Sizing

Exhaust ducts serving the required kitchen, bathroom, water closet room and other supplemental exhaust air intakes are to be sized according to Part 6 OBC except that they may be sized according to Table 9.32.3.5. where

- the total duct length does not exceed 9 m, and
- the number of elbows does not exceed 4,

and, in any case, they must not be smaller than recommended by the manufacturers of the fans.

Table 9.32.3.5.
Kitchen, Bathroom and Water Closet Room Exhaust Duct Size
Forming Part of Sentence 9.32.3.5.(4)

TABLE 6-5

Fan Capacity, L/s	Minimum *Exhaust Duct* Diameter[1]	
	Ducts Connected to Inlet & Outlet of Exhaust Fan, mm	Ducts Connected to One Side Only of Exhaust Fan, mm
25	125	125
50	150	150
Column 1	2	3

Note to Table 9.32.3.5.:
[1] Where flexible duct is used, the duct diameter is to be increased by 25 mm.

Supplemental Exhaust Control

The supplemental exhaust fan is to be controlled by a manual switch located in the room served by the exhaust fan.

Where the supplemental exhaust is provided by an exhaust fan serving multiple exhaust air intakes, the exhaust fan is required to be controlled by a manual switch located in each room served by that exhaust fan and wired in parallel.

Where the supplemental exhaust is provided by a principal exhaust fan serving multiple exhaust air intakes, the principal exhaust fan is required to be controlled by a manual switch located in each room that is served by that exhaust fan and wired in parallel with the principal fan's required manual switch.

A supplemental exhaust fan may be controlled by a dehumidistat or other automatic control device where the required manual switch is capable of activating the fan regardless of the setting of the automatic control.

The supplemental exhaust may be provided by means of a heat recovery ventilator installed in accordance with Part 9 OBC.

EXAMPLE QUESTION

A *dwelling unit* has 3 bedrooms and a minimum total ventilation capacity requirement of 80 L/s. What is the minimum required supplemental exhaust capacity in L/s?

a) 37.5;
b) 50.0;
c) 30.0;
d) Part 6 design.

OBC Reference _____

EXERCISE #6-4

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. Which one of the following rooms does NOT require an exhaust air intake?
   a) Kitchen;
   b) Main floor powder room;
   c) Laundry;
   d) Bathroom.

OBC Reference _____

2. *Exhaust ducts* serving the required kitchen, bathroom, water closet room and other supplemental exhaust air intakes are to be sized according to Part 6 OBC except that they may be sized according to Table 9.32.3.5., provided?
    a) The total duct length does not exceed 10 m.
    b) The number of elbows does exceed 4.
    c) Where flexible duct is used the diameter is decreased by 25 mm;
    d) Size is not to be smaller than recommended by the manufacturers of the fans.

OBC Reference _____

3. Where the exhaust system is designed in accordance with Section 9.32, what is the minimum supplementary *exhaust duct* size diameter (in mm) for a fan capacity of 25 L/s connected to flexible ducts?
    a) 125;
    b) 175;
    c) 150;
    d) 100.

OBC Reference _____

4. Which one of the following arrangements is a requirement of the OBC regarding a manual switch for a supplemental exhaust fan?
    a) Manual switch located in the room it serves, and is capable of activating the fan regardless of the state of the automatic control;
    b) Maintains humidity to +/- 10%;
    c) 100% capacity control is available;
    d) Automatic shut-off with timer.

OBC Reference _____

VENTILATION SYSTEM COUPLED WITH FORCED AIR HEATING SYSTEMS

As per Article 9.32.3.6., requirements for a mechanical ventilation system in a *dwelling unit* that contains a forced air heating system that is used for delivery of ventilation air are,

- In a Type I *dwelling unit*, a ventilation supply inlet is not required.
- In a Type II *dwelling unit*, the mechanical ventilation system is to include a heat recovery ventilator, coupled to the forced air heating system, installed in accordance with Part 9 OBC.

The forced air heating system circulation fan is to be controlled by a manual switch (identified by the words CIRCULATION FAN) located adjacent to the principal exhaust ventilation fan switch identified with the words VENTILATION FAN.

VENTILATION SYSTEM NOT COUPLED WITH FORCED AIR HEATING SYSTEMS

Article 9.32.3.7. addresses ventilation systems not coupled with forced air heating systems. A mechanical ventilation system in a *dwelling unit* that does not contain a forced air heating system, or contains a forced air heating system that is not used for circulation of the ventilation air, is to include a heat recovery ventilator installed in accordance with part 9 OBC.

Main Duct

Outdoor air is to be distributed by a ductwork system from the heat recovery ventilator to each bedroom, to any *storey* without a bedroom and, if there is no *storey* without a bedroom, to the principal living area.

A *supply duct* from the outdoors to the heat recovery ventilator and a main distribution trunk duct is to be provided and be sized according to Part 6 OBC, except that, the *supply duct* and the main distribution trunk duct may be sized according to Table 9.32.3.7.A. under certain conditions. The Table may be used where the total duct length from the outdoor hood to any supply register does

not exceed 21 m, and the total number of fittings does not exceed 8.

Table 9.32.3.7.A.
Minimum Outdoor Air Supply and Main Trunk Duct Sizes
Forming Part of Sentence 9.32.3.7.(5)

TABLE 6-6

Number of Bedrooms in *Dwelling Unit*	Minimum Outdoor Air Supply And Main Distribution Trunk Duct Diameter, mm
1	150
2	150
3	175
4	175
More than 4	Part 6 design
Column 1	2

The outside air *supply duct* required above must not be considered to provide combustion and/or dilution air to fuel-burning *appliances*.

Branch Duct

Branch *supply ducts* leading from the main distribution trunk duct to the rooms to which outdoor air is to be distributed are to be provided and sized according to Part 6 OBC, except that the branch *supply ducts* may be sized according to Table 9.32.3.7.B where

- the total duct length from outdoor hood to supply register does not exceed 21 m, and
- the total number of fittings does not exceed 8.

Table 9.32.3.7.B.
Minimum Branch Supply Duct Sizes
Forming Part of Sentence 9.32.3.7.(7)

TABLE 6-7

Room, Space Or *Storey* Served	Minimum Branch *Supply Duct* Diameter	
	1 and 2 Bedroom *Dwelling Units*, mm	3 and 4 Bedroom *Dwelling Units*, mm
Master bedroom	100	100
Other bedrooms	75	75
Storey with no bedrooms or living area	75	100
Column 1	2	3

Where the *dwelling unit* has more than 4 bedrooms, ducting is to be sized according to Part 6 OBC.

All branch *supply ducts* that are not fitted with diffusers with adjustable balance stops are to be supplied with accessible dampers which can be adjusted and fixed in their adjusted positions and that include devices to indicate the positions of the dampers.

Provision for Air Circulation Path

Provision is to be made for the free flow of air to all rooms by leaving gaps beneath doors, using louvered doors or installing grilles in doors.

EXAMPLE QUESTION

For a Type I *dwelling unit*, which one of the following is NOT a requirement for a mechanical ventilation system in a *dwelling unit* that contains a forced air heating system that is used for delivery of ventilation air?

a) Circulation fan is to be controlled by a manual switch (identified by the words; CIRCULATION FAN)
b) Ventilation supply inlet is not required;
c) Manual circulation switch to be located adjacent to switch for VENTILATION FAN;
d) Heat recovery ventilator required.

OBC Reference _____

EXERCISE #6-5

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. A mechanical ventilation system in a *dwelling unit* that does not contain a forced air heating system, or contains a forced air heating system that is not used for circulation of the ventilation air, is to include a heat recovery ventilator installed in accordance with part 9 OBC. Which space or room does NOT require outdoor air to be distributed by a ductwork system from the heat recovery ventilator?
    a) To each bedroom;
    b) To the laundry room;
    c) To the principal living area having no bedroom;
    d) To any *storey* without a bedroom.

OBC Reference _____

2. A *supply duct* from the outdoors to the heat recovery ventilator and a main distribution trunk duct is to be provided and be sized according to Part 6 OBC, except that, the *supply duct* and the main distribution trunk duct may be sized according to Table 9.32.3.7.A. Where a Part 9 OBC design is used, what is the minimum outdoor air supply and main distribution trunk duct diameter (in mm) for a *dwelling unit* with 3 bedrooms?
    a) 125;
    b) 175;
    c) 150;
    d) Part 6 design.

OBC Reference _____

3. Branch *supply ducts* leading from the main distribution trunk duct to the rooms to which outdoor air is to be distributed are to be provided and sized according to Part 6 OBC, except that the branch *supply ducts* may be sized according to Table 9.32.3.7.B. Where a Part 9 OBC design is used, which one of the following arrangements is a requirement of the OBC regarding branch *supply ducts*?
    a) The total duct length from outdoor hood to supply register does not exceed 21 m;
    b) The total number of diffusers does not exceed 8;
    c) The total duct length from the main duct to supply register does not exceed 21 m;
    d) The total number of fittings exceeds 8.

OBC Reference _____

4. Which one of the following is NOT a suggested method or arrangement for the provision of the free flow of air to all rooms?
    a) Leaving gaps beneath doors;
    b) Using louvered doors;
    c) Provide removable door stops to keep doors ajar;
    d) Installing grilles in doors.

OBC Reference _____

PROTECTION AGAINST DEPRESSURIZATION

Article 9.32.3.8. addresses depressurization. When determining the need to provide protection against depressurization, consideration must be given to

- whether the presence of soil gas is deemed to be a problem, and
- the presence of solid fuel-fired combustion *appliances*.

Where a solid fuel-fired combustion *appliance* is installed, the ventilation system is to include a heat recovery ventilator that is designed to operate so that the flow of exhaust air

does not exceed the flow of intake air in any operating mode, and that complies with Article 9.32.3.11.

Fan Ratings

Article 9.32.3.9. addresses fan ratings. Mechanical ventilation devices are to conform to CSA-C22.2 No. 113, "Fans and Ventilators".

Capacity ratings for required fans are to be based on a static pressure differential depending on ductwork connected as

- 50 Pa – duct on both sides,
- 25 Pa – duct on one side, or
- 7.5 Pa – duct on neither side.

Capacity and sound ratings for required fans (including heat recovery ventilators) are to be determined in accordance with CAN/CSA-C260-M, "Rating the Performance of Residential Mechanical Ventilating Equipment" (capacity and sound), or HVI 916, "Airflow Test Procedure" (capacity) and HIV 915, "Procedure for Loudness Rating of Residential Fan Products" (sound) except

- exhaust fans required to make up any part of the total ventilation capacity are to have a sound rating not greater than that specified in Table 9.32.3.9.

Table 9.32.3.9.
Fan Sound Rating
Forming Part of Sentence 9.32.3.9.(3)

TABLE 6-8

Type of Fan	Maximum Sound Rating, sones	
	Rated according to CAN/CSA-C260-M	Rated according to HVI 915
Principal exhaust fan	2.0	2.5
Supplemental exhaust fans installed in bathrooms and water closet rooms and their make-up fans	2.5	3.5
Supplemental exhaust fans installed in kitchens and their make-up air fans	no rating required	no rating required
Column 1	2	3

Note to Table 6-8: Kitchen fans are not required to have a sound rating when the fans are not part of the required total capacity. If the kitchen fans are part of the required total capacity then they are required to comply with the sound ratings.

Required fans are to be installed according to the manufacturer's instructions.

MECHANICAL VENTILATION DUCTS

Article 9.32.3.10. deals with sizing, insulation and installation of ducts. Ventilation ducts are to conform to the requirements of Part 6 OBC for *supply ducts* except that *exhaust ducts* that serve only a bathroom or water closet room may be of *combustible* material provided the duct is reasonably airtight and constructed of a material impervious to water.

Exhaust ducts must not discharge into heated or unheated enclosed spaces.

Insulation of Ducts

Where an *exhaust duct* passes through or is adjacent to unheated space, the duct is to be insulated to not less than RSI 0.5.

Where a *supply duct* carrying outdoor air that is not heated or not mixed with indoor air, passes through heated space, it is to be insulated to not less than RSI 0.5. Where such a duct is exposed in the heated space for more than 3 m of length, it must be insulated to not less than the values listed in Table 9.32.3.10.A.

Table 9.32.3.10.A
Insulation of Fresh Air Supply Ducts
Forming Part of Sentence 9.32.3.10.(4)

TABLE 6-9

Outside Winter Design Temperature as per Supplementary Standard SB-1[1], °C	Minimum Thermal Resistance, RSI
-7 to –11	0.5
-12 to –17	0.9
-18 to –24	1.2
-25 to –29	1.4
-30 to –34	1.8
-35 and colder	2.1
Column 1	2

Note to Table 9.32.3.10.A:
[1] The outside winter design temperatures are to be those listed for the January 2.5 per cent values.

Kitchen Duct Arrangement and Accessories

A kitchen *exhaust duct* not equipped with a filter at the inlet end is to be designed and installed so that the entire duct can be cleaned.

Ductwork for range hoods and range-top fans are to be equipped with a grease filter at the intake.

Ductwork for range hoods and range-top fans is to be of *noncombustible*, corrosion-resistant material and is to lead directly to the outdoors without connection to other exhaust fans or ducts.

Duct Support and Sealing

All ductwork is to be permanently supported or clipped to prevent sagging, excessive movement and vibration.

All ducting connected to supply and exhaust fans is to be constructed so as to inhibit air leakage at joints.

Rectangular Duct

Where rectangular duct is used in place of round duct, it is to be selected according to Table 9.32.3.10.B.

Table 9.32.3.10.B
Equivalent Duct Sizes
Forming Part of Sentence 9.32.3.10.(10)

TABLE 6-10

Required Round Duct Size, mm	Permitted Equivalent Rectangular Duct Size, mm			
	Stack Duct	100 mm Depth	125 mm Depth	150 mm Depth
75	82 x 250	57 x 100		
100	82 x 250	89 x 100	75 x 125	75 x 150
125	82 x 250	125 x 100	100 x 125	89 x 150
150	82 x 300	200 x 100	150 x 125	125 x 150
175	82 x 350	275 x 100	200 x 125	175 x 150
More Than 175	Part 6 Design	Part 6 Design	Part 6 Design	Part 6 Design
Column 1	2	3	4	5

EXAMPLE QUESTION

Which one of the following operational situations is to be avoided, regarding depressurization?

a) Flow of intake air does not exceed the flow of exhaust air;
b) Flow of exhaust air equals the flow of intake air;
c) Flow of exhaust air does not exceed the flow of intake air;
d) Presence of soil gas.

OBC Reference _____

EXERCISE #6-6

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple choice method.

1. Mechanical ventilation devices are to conform to CSA-C22.2 No. 113, "Fans and Ventilators". At what static pressure differential (in Pa) are fan capacity ratings determined for fans with duct connected on one side?
    a) 7.5;
    b) 12;
    c) 25;
    d) 50.

OBC Reference _____

2. Which one of the following discharge arrangements does NOT conform to the OBC, regarding the discharge of *exhaust ducts*?
    a) Into a heat recovery ventilator;
    b) Into an exterior wall exhaust discharge vent;
    c) Into an attic space;
    d) Into an exterior roof exhaust discharge vent.

OBC Reference _____

3. A single-family house in Bradford, Ontario contains a *supply duct* carrying outdoor-unheated air passing through 3 m of heated space and requires insulation. What is the minimum RSI value of insulation required?
    a) 0.5;
    b) 1.2;
    c) 1.4;
    d) 4 400.

OBC Reference _____

4. Which one of the following rectangular duct sizes (in mm) is NOT permitted as an equivalent for a round duct size of diameter 100 mm?
    a) 75 x 125;
    b) 75 x 150;
    c) 89 x 89;
    d) 89 x 100.

OBC Reference _____

HEAT RECOVERY VENTILATORS

Article 9.32.3.11. addresses heat recovery ventilators. Heat recovery ventilators are to be designed to provide a minimum 55% sensible heat recovery efficiency when tested to the low temperature thermal and ventilation performance test method set out in CAN/CSA-C439-M, "Rating the Performance of Heat/Energy-Recovery Ventilators". Station 1 test temperature to be −25°C at an air flow not less than 30 L/s.

Connections Requirements

Where a heat recovery ventilator is connected to a forced air heating system, the supply side of the ventilator is to be directly connected to the return air side of the forced air heating system.

Two or more heat recovery ventilators must not be connected in parallel air flow to a common air *supply duct* unless specifically recommended by the manufacturer.

Two or more heat recovery ventilators must not be connected in parallel air flow to a common downstream *exhaust duct*.

Condensate Control

Free flow of condensate is to be provided in accordance with the manufacturer's recommendations or, in their absence, a condensate drain of minimum 1/2 inch nominal pipe size pitched in the direction of flow and complete with a trap or condensate pump with sufficient capacity is to be installed.

Heat recovery ventilators installed in unheated spaces are to be installed so as to avoid condensation of moisture on fans and motors in exhaust air, in accordance with the manufacturer's instructions.

The heat recovery ventilator and all condensate lines are to be installed in a space where the ambient temperature will not adversely affect the operation of the system.

Start-up and Operation

All start-up procedures recommended by the manufacturer including air balancing and air flow determination are to be followed.

When operating at required capacity the supply and exhaust airflow rates of the heat recovery ventilator are to be balanced so that the value of the lesser flow is to be at least 90% of the value of the greater flow, unless otherwise recommended by the manufacturer.

Outdoor Intake and Exhaust Openings

Separate air intake and exhaust outlet openings, when located on the same wall or roof, are to be installed so as to avoid contamination of the ventilation air by the exhaust air.

Intake openings are to be located so as to avoid contamination of the ventilation air from other local sources such as automobile exhausts and exhaust from adjacent *buildings*.

Air intakes are to be clearly labeled as such for identification from locations outside the *dwelling unit*.

Clearances

The distance from the bottom of an air intake opening to finished ground level or to any nearer and lower permanent horizontal surface must be not less than 450 mm or the depth of expected snow accumulation, whichever is greater.

The distance from the bottom of an exhaust outlet to finished ground level or to any nearer and lower permanent horizontal surface must be not less than 100 mm.

The distance separating air intakes from *building* envelope penetrations that are potential sources of contaminants, such as *gas vents* or oil fill pipes, must be not less than 900 mm.

Opening Protection and Backdraft Prevention

Where air intake and exhaust openings are in exposed locations, provision is to be made to protect them from the entry of precipitation by the use of louvers, weather cowls or other suitable protection.

Air intake openings are to incorporate screens or grilles to protect against the entry of animals and insects.

Except for exhaust outlets serving heat recovery ventilators, exhaust outlets are to incorporate backdraft dampers.

All exhaust outlets require a screen, , except on a clothes dryers exhaust outlet The screen requires a mesh size not larger than 15 mm, unless climatic conditions may dictate larger openings, to prevent blockage by ice for example.

Where a screen or grille is required and has a mesh size of less than 6 mm, the screen or grille is to be removable for cleaning.

The gross area of the screens or grilles installed in intake and exhaust openings are to be three times that of the duct served.

The net free area of an air intake or exhaust outlet is to be equal to or greater than the cross-sectional area of the duct served.

Screens and grilles are to be of corrosion-resistant material.

Ventilation Equipment Installation

Installation of fans and heat recovery ventilators are to be in accordance with manufacturer's instructions for minimizing noise and vibration transmission and achieving the required sound rating.

Where flow-regulating dampers are required, they are to be adjustable and accessible without requiring the removal of fans, motors, or insulating materials and without the need for specialized tools.

Ventilation equipment is to be accessible for inspection, maintenance, repair and cleaning.

Ventilation equipment installed in unheated spaces is to be installed so as to avoid condensation of moisture on fans and motors in accordance with the manufacturer's instructions.

EXAMPLE QUESTION

A heat recovery ventilator is connected to a forced air heating system. Which one of the following connections is permitted by the OBC?

a) Supply side of the forced air heating system;
b) In parallel air flow to the common downstream *exhaust duct;*
c) To the laundry equipment exhaust;
d) Return side of the forced air heating system.

OBC Reference _____

EXERCISE #6-7

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. Heat recovery ventilators and all condensate lines are to be installed in spaces where ambient conditions will not adversely affect the operation of the system. Which one of the following ambient conditions is of most concern?
   a) Humidity;
   b) Elevated temperatures;
   c) Dust, dirt and mould;
   d) Freezing temperatures.

OBC Reference _____

2. The distance separating air intakes from *building* envelope penetrations that are potential sources of contaminants, such as *gas vents* or oil fill pipes, must be not less than what value (in mm)?
   a) 100;
   b) 450;
   c) 900;
   d) Good engineering practice.

OBC Reference _____

3. The gross area of the screens or grilles installed in intake and exhaust openings is to what ratio of the area of duct served?
    a) Equal;
    b) 0.3;
    c) 3.0;
    d) 30.

OBC Reference _____

4. Which of the following is a requirement of the OBC with regard to required flow-regulating dampers?
    a) removal of fans and motors;
    b) adjustable and accessible;
    c) specialized tools;
    d) removal of insulation.

OBC Reference _____

Ontario

Ministry of Municipal Affairs and Housing

HVAC-HOUSE

PARTICIPANT'S MODULE #7

Heating and Air-Conditioning

May 2008

INTRODUCTION

This module covers design and installation requirements for HVAC systems in OBC Part 9 *buildings*. Particular focus is given to the concepts of indoor and outdoor design temperatures and to carbon monoxide detector requirements.

OBJECTIVES

Upon completion of this module, participants will:

- Determine various design and installation requirements;
- Know and understand the standards for solid fuel burning appliances;
- Communicate the concept of required heating systems;
- State the requirements for indoor design temperatures;
- Determine information in outdoor design temperatures tables;
- Know and understand the OBC requirements dealing with carbon monoxide.

HEATING AND AIR-CONDITIONING

Design and Installation Requirements

The design and installation of central heating systems including requirements for combustion air, are to conform to the requirements in both Part 6 OBC and to Section 9.33. Heating and Air-Conditioning.

If you read Sentence 9.33.1.1.(2) you will see that the design and installation of *air-conditioning* systems are to conform to Part 6 OBC only. This is the only requirement in Section 9.33. that addresses air-conditioning.

Repairs, adjustments or component replacements that change the capacity or extent of safety of an existing heating, ventilating or *air-conditioning* system and that alter the method of operation are to conform to the OBC as per

Sentence 9.33.1.1.(3).

Solid Fuel-Burning Appliances

The design and installation of solid-fuel burning *stoves*, *ranges* and *space heaters*, including the requirements for combustion air, are to conform to CAN/CSA-B365-M, "Installation Code for Solid-Fuel Burning Appliances and Equipment".

Structural Movement

Just as water heaters are required to be secured to the structure to resist overturning or displacement in an earthquake, the same is required for heating and air-conditioning equipment that has fuel or power connections. Sentence 9.33.1.3.(1) requires that heating and air-conditioning equipment be secured for locations where the spectral response acceleration, $S_a(0.2)$, is greater than 0.55. This value can be determined from Supplementary Standard SB-1 (discussed below under Outdoor Design Temperature).

Required Heating Systems – Residential

Residential *buildings* intended for use in the winter months on a continuing basis are to be equipped with heating facilities conforming to Section 9.33 Heating and Air-Conditioning.

Indoor Design Temperatures

At the outside design temperature, required heating facilities are to be capable of maintaining an indoor air temperature of not less than

- 22°C in all living spaces,
- 22°C in unfinished *basements*, and
- 15°C in heated crawl spaces.

The OBC provides exclusions in Article 9.36.2.1. for cottages, which are *buildings* used or intended to be used as seasonal recreational *buildings*. With respect to heating and air-conditioning, where these systems are provided they do not need to meet the minimum indoor design temperatures of Article 9.33.3.1. It is important to note however, that

where heating and/or air-conditioning systems are provided in a cottage, they are to otherwise comply with the full requirements of Part 9 OBC unless specifically exempted. For example, a woodstove installed in a cottage will be required to conform to CAN/CSA-B365-M, "Installation Code for Solid-Fuel-Burning Appliances and Equipment".

Outdoor Design Temperatures

The outdoor conditions to be used in designing heating, ventilating and *air-conditioning* systems are to be the appropriate values for the Municipality as set out in Supplementary Standard SB-1, using 2.5 per cent design temperature criteria.

An example page from Supplementary Standard SB-1 is given.

Location	Design Temperature				Degree Days Below 18°C	15 Min Rainfall, mm	One Day Rainfall, 1/50, mm	Annual Rainfall, mm	Annual Total Precipitation, mm	Driving Rain Wind Pressures, Pa, 1/5	Snow Load, kPa, 1/50		Hourly Wind Pressures, kPa		Seismic Data				
	January		July 2.5%										1/10	1/50	$S_a(0.2)$	$S_a(0.5)$	$S_a(1.0)$	$S_a(2.0)$	PGA
	2.5%, °C	1%, °C	Dry, °C	Wet, °C							S_s	S_r							
Cambridge	-18	-20	29	23	4150	25	113	800	890	160	1.6	0.4	0.26	0.35	0.22	0.110	0.050	0.013	0.140
Campbellford	-23	-26	30	23	4450	25	97	730	850	160	1.7	0.4	0.29	0.41	0.23	0.130	0.067	0.019	0.120
Cannington	-24	-26	30	23	4550	28	108	740	950	120	2.2	0.4	0.24	0.36	0.17	0.100	0.054	0.015	0.081
Carleton Place	-25	-27	30	23	4800	25	86	730	850	160	2.5	0.4	0.30	0.41	0.52	0.250	0.110	0.036	0.340
Cavan	-22	-25	30	23	4500	28	97	740	850	140	2.0	0.4	0.31	0.44	0.20	0.120	0.060	0.017	0.100
Centralia	-17	-19	30	23	4100	25	103	820	1000	180	2.3	0.4	0.37	0.53	0.14	0.080	0.043	0.011	0.081
Chapleau	-35	-38	27	21	6200	23	97	530	850	80	4.0	0.4	0.19	0.28	0.12	0.058	0.029	0.009	0.059
Chatham	-16	-18	31	24	3750	28	103	800	850	180	1.0	0.4	0.32	0.43	0.20	0.095	0.044	0.012	0.130
Chesley	-19	-21	29	22	4500	28	103	810	1125	140	2.8	0.4	0.33	0.48	0.13	0.077	0.041	0.011	0.063
Clinton	-17	-19	29	23	4150	23	103	810	1000	160	2.6	0.4	0.37	0.53	0.13	0.075	0.041	0.011	0.065
Coboconk	-25	-27	29	22	4750	25	108	740	950	120	2.5	0.4	0.26	0.35	0.18	0.110	0.056	0.016	0.080
Cobourg	-21	-23	30	23	4100	23	97	760	825	160	1.2	0.4	0.46	0.59	0.24	0.120	0.065	0.017	0.130
Cochrane	-34	-36	29	21	6400	20	86	575	875	80	2.8	0.3	0.26	0.35	0.21	0.100	0.046	0.014	0.150
Colborne	-21	-23	29	23	4100	23	86	760	850	160	1.6	0.4	0.44	0.56	0.24	0.130	0.067	0.018	0.140
Collingwood	-22	-24	29	22	4300	28	103	720	950	160	2.7	0.4	0.25	0.39	0.14	0.087	0.045	0.013	0.069
Cornwall	-23	-25	30	23	4350	28	103	780	960	180	2.2	0.4	0.30	0.41	0.67	0.310	0.140	0.045	0.410
Corunna	-16	-18	31	23	3800	23	97	760	800	180	1.0	0.4	0.35	0.47	0.14	0.076	0.040	0.011	0.084
Deep River	-29	-32	30	22	5050	23	92	650	850	100	2.5	0.4	0.26	0.35	0.66	0.320	0.130	0.043	0.420
Deseronto	-22	-24	28	23	4200	23	97	760	900	160	1.9	0.4	0.32	0.43	0.27	0.150	0.076	0.021	0.140
Dorchester	-18	-20	30	23	4100	28	103	850	950	180	1.9	0.4	0.33	0.48	0.19	0.096	0.048	0.013	0.120
Dorion	-33	-35	28	21	5950	20	103	550	725	160	2.8	0.4	0.30	0.39	0.12	0.056	0.023	0.006	0.059
Dresden	-16	-18	31	24	3750	28	97	760	820	180	1	0.4	0.32	0.43	0.18	0.091	0.044	0.012	0.120
Dryden	-34	-36	27	22	6000	25	97	550	700	120	2.4	0.3	0.21	0.27	0.12	0.056	0.023	0.006	0.059
Dunnville	-15	-17	30	24	3900	23	119	830	950	160	2	0.4	0.33	0.42	0.35	0.170	0.062	0.019	0.260
Durham	-20	-22	29	22	4700	28	103	815	1025	140	2.8	0.4	0.31	0.44	0.14	0.080	0.042	0.012	0.068
Column 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

FIGURE 7-1

By finding the appropriate row for the Municipality or location of the *building*, or the nearest location, you can find the appropriate 2.5 per cent design temperature in Column 2.

EXAMPLE QUESTION

Which one of the following HVAC system characteristics, when altered by repair, adjustment, or component replacement, does NOT constitute an alteration that requires conformance to the OBC?

a) Method of operation;
b) Energy efficiency;
c) Extent of safety;
d) System capacity.

OBC Reference _____

EXERCISE #7-1

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. A summer cottage is used occasionally for winter activities. A small heater is installed to provide minimal heat in the winter months. What minimum indoor air temperature for living spaces is required by the OBC?
   a) 22 °C;
   b) 55 °F;
   c) 15 °C;
   d) No minimum temperature required.

OBC Reference _____

2. What is the outdoor design temperature value for Cobourg Ontario?
    a) –21 °C;
    b) –23 °C;
    c) –25 °C;
    d) 22 °C in all living spaces.

OBC Reference _____

3. Which one of the following solid-fuel burning devices does NOT required conformance to the CAN/CSA-B365-M, "Installation Code for Solid-Fuel Burning Appliances and Equipment"?
    a) *Range;*
    b) Masonry fireplace;
    c) *Stove;*
    d) *Space heater.*

OBC Reference _____

4. Would a gas-fired furnace in a house in Ottawa be required to be secured to the structure?
    a) Yes, because the S_a is greater than 0.55;
    b) Yes, because the S_a is less than 0.55;
    c) No, because the S_a is greater than 0.55;
    d) No, because the S_a is less than 0.55.

OBC Reference _____

5. What is the heating degree day value for Campbellford, Ontario?
    a) 4 550;
    b) 4 150;
    c) 4 450;
    d) 850.

OBC Reference _____

CARBON MONOXIDE DETECTORS

The OBC requirements for carbon monoxide detectors apply to every *building* that contains a *residential occupancy* and contains a fuel-burning *appliance* or a *storage garage*. The requirements for carbon monoxide detectors are in Subsection 9.33.4.

Location of Carbon Monoxide Detectors

Where a fuel-burning *appliance* is installed in a *suite* of *residential occupancy (such as a house or an apartment)*, a carbon monoxide detector is to be installed adjacent to each sleeping area in the *suite*.

Where a fuel-burning *appliance* is installed in a *service room* that is not in a *suite* of *residential occupancy*, a carbon monoxide detector is to be installed

- adjacent to each sleeping area in every *suite* of *residential occupancy* that is adjacent to the *service room*, and
- in the *service room*.

Where a *storage garage* is located in a building containing a *residential occupancy*, a carbon monoxide detector is to be installed adjacent to each sleeping area in every *suite* of *residential occupancy* that is adjacent to the *storage garage*.

Where a *storage garage* serves only the *dwelling unit* to which it is attached or built in, a carbon monoxide detector is to be installed adjacent to each sleeping area in the *dwelling unit*.

Installation and Conformance to Standards

The required carbon monoxide detector is to be

- permanently connected to an electrical circuit and must have no disconnect switch between the overcurrent device and the carbon monoxide detector,
- be wired so that its activation will activate all carbon monoxide detectors within the *suite*, where located within a *suite* of *residential occupancy*,
- be equipped with an alarm that is audible within bedrooms when the intervening doors are closed, where located adjacent to a sleeping area.

The required carbon monoxide detector is to conform to one of the following standards:

- CAN/CSA 6.19, "Residential Carbon Monoxide Alarming Devices", or
- UL 2034, "Single and Multiple Station Carbon Monoxide Alarms".

EXAMPLE QUESTION

Where a fuel-burning *appliance* is installed in a *service room* that is not in a *suite* of *residential occupancy*, a carbon monoxide detector is to be installed in which locations?

a) Adjacent to each sleeping area in all *suites;*
b) In the service room;
c) Adjacent to each sleeping area in the *suites* that are adjacent to the service room;
d) Adjacent to each sleeping area in the *suites* that are adjacent to the service room , and in the service room.

OBC Reference _____

EXERCISE #7-2

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple-choice method.

1. In the supply line electrical circuit for a carbon monoxide detector, which two devices are permanently connected without a facility for disconnection?
   a) Overcurrent device and disconnect switch;
   b) Disconnect switch and carbon monoxide detector;
   c) Overcurrent device and carbon monoxide; detector
   d) Carbon monoxide detector and audible alarm.

OBC Reference _____

2. Where a *storage garage* is located in a single *dwelling unit,* where are carbon monoxide detectors to be located?
    a) In each sleeping area;
    b) Adjacent to every *suite* and in the *storage garage;*
    c) Adjacent to each sleeping area in the *dwelling unit;*
    d) In *storage garage* only.

OBC Reference _____

3. Where there multiple carbon monoxide detectors are located within a *suite* of *residential occupancy*, which of the following arrangements is required to conform to the OBC?
    a) Wired with a common disconnect switch;
    b) Wired so the activation of one will activate all;
    c) Wired to a single audible alarm point;
    d) Wired so the activation of one will activate the carbon monoxide detector in the garage.

OBC Reference _____

4. The OBC requirements for carbon monoxide detectors apply to a *building* that contains?
    a) a *residential occupancy* containing an electric stove;
    b) an *assembly occupancy* and containing a *storage garage;*
    c) a *repair garage* adjacent to *personal services occupancy;*
    d) a *residential occupancy* containing a fuel-burning *appliance.*

OBC Reference _____

Ontario

Ministry of Municipal Affairs and Housing

HVAC-HOUSE

PARTICIPANT'S MODULE #8

Renovation – Compliance Alternatives

May 2008

INTRODUCTION

This module examines the requirements and options available to OBC compliance for alterations or extensions to existing *buildings* (5 years of age or older) and *building systems* and the concept of *compliance alternatives* available for possible application to new or existing *buildings*. Consistent with the scope of this course, focus will be maintained on subject matter regarding Part 9 Housing and Small Buildings.

OBJECTIVES

Upon completion of this module, participants will:

- Communicate the applicability of Part 11 to HVAC – House;
- Summarize Part 11 terminology;
- Know and understand the allowable *compliance alternatives* to Parts 6 and 9;
- Use selection criteria for application of Compliance Alternatives.

DEFINITIONS

Building system means a combination of elements or components that form a complete major division of *construction* in the design of a *building* or part of a *building*, including:

- a structural or framing system,
- a waterproofing system,
- a *drainage system*,
- an exterior cladding system,
- a roofing system,
- a window system,
- a partition system,
- a corridor system,
- a stair system,
- a fire alarm and detection system,
- a sprinkler system,
- a heating, ventilation or *air conditioning* system,
- a *foundation* system,
- a standpipe and hose system,

- a flooring system,
- a *plumbing system*,
- a *sewage system*
- or an electrical system.

Compliance alternative means a substitute for a requirement in another Part of Division B that is listed in Part 10 or 11 of Division B, and "C.A." has a corresponding meaning.

NEW AND EXISTING BUILDING SYSTEMS

MATERIAL ALTERATION OR REPAIR OF A BUILDING SYSTEM

Where an existing *building system* is materially altered or repaired, the *performance level* of the *building* after the material alteration or repair is to be at least equal to the *performance level* of the *building* prior to the material alteration or repair.

New Building Systems and Extension of Existing Building Systems – Application of Part 11 OBC

The design and *construction* of a new *building system* or the extension of an existing *building system*, is to comply with all other Parts of the OBC. Exceptions are as described in Basic Renovation and Compliance Alternatives in the following sections.

Where an existing *building* is extended, Part 11 of the OBC applies to the existing portion of the *building* and the extended portion of the *building* must comply with all other Parts of the OBC.

Basic Renovation

Construction may be carried out to maintain the existing *performance level* of all or part of an existing *building (at least 5 years old)*, by the reuse, relocation or extension of the same or similar materials or components, to

- retain the existing character,
- structural uniqueness,
- heritage value,
- or aesthetic appearance of all or part of the *building*,

if, the *construction* will not adversely affect the early warning and evacuation systems, fire separations, the structural adequacy or create an unhealthy environment in the *building*.

However, *construction* in respect of a *hotel* may only be carried out in accordance with the above sentence provided that the *construction* will be in conformance with Part 9 of Division B of the Ontario Fire Code made under the *Fire Protection and Prevention Act, 1997*.

Extensive Renovation

Extensive renovation is where existing interior walls or ceilings or floor assemblies or roof assemblies are substantially removed in an existing *building* and new interior walls, ceilings, or floor assemblies are installed in the *building*. Structural and fire-resistance elements are then to be constructed in compliance with the requirements of the other Parts of the Code.

Compliance Alternatives

A *compliance alternative* shown in Tables 11.5.1.1.A., 11.5.1.1.B., 11.5.1.1.C., 11.5.1.1.D/E. or 11.5.1.1.F. may be substituted for a requirement contained in Part 3, 4, 5, 6, 7 or 8 of the OBC where the *chief building official* is satisfied that compliance with the requirement is impracticable because

- of structural or *construction* difficulties, or
- it is detrimental to the preservation of a *heritage building*.

The letter designation of these tables matches with the occupancy classifications. For this course HVAC – HOUSE, you should take a look at Table 11.5.1.1.C. since this applies to residential occupancies.

Of most interest to this course, Compliance Alternatives in any of the tables A through F, may be substituted for a requirement contained in Part 9 OBC <u>without</u> satisfying the *chief building official* that compliance with the requirement is impracticable.

EXAMPLE QUESTION

Where an existing *building system* is materially altered or repaired, which one of the following best describes OBC requirements for the work?

a) Resulting *performance level* must conform to all Parts of the OBC;
b) Resulting *performance level* must be greater than prior to alteration or repair;
c) Resulting *performance level* must be at least equal to the level prior to the work;
d) Resulting *performance level* must be more thermally efficient than prior to work.

OBC Reference _____

EXERCISE #8-1

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple choice method.

1. In a basic renovation construction may be carried out to reuse, relocate or extend the same or similar components as existing provided which of the following is satisfied?
   a) Existing *performance level* is maintained;
   b) Existing *performance level* is exceeded;
   c) Existing *performance level* is exceeded for life safety elements;
   d) Existing *performance level* does not matter since the construction must meet current Code requirements from other Parts.

OBC Reference _____

2. Where can *compliance alternatives* Tables be found in the OBC?
    a) In the OBC Part where the initial requirement is stated;
    b) In Part 7;
    c) Listed in Part 11;
    d) Listed in Part 12.

OBC Reference _____

3. Which one of the following is a fundamental condition required to satisfy the *chief building official* that a *compliance alternative* for a Part 6 requirement may be utilized?
    a) Financial hardship;
    b) *Performance level* of the *building* after compliance *alternative will* be less than the *performance level* prior;
    c) Preservation of aesthetic appearance ;
    d) Structural or construction difficulties or preservation of a *heritage building*.

OBC Reference _____

4. The design and *construction* of a new *building system* or the extension of an existing *building system* (when not considered a basic renovation or applying a compliance alternative) is to comply with which one of the following?
    a) All of the OBC excluding Part 11;
    b) OBC Part 11 for existing, all other Parts for new;
    c) All other Parts of the OBC except for Basic Renovations and compliance alternatives;
    d) OBC Part 11 only.

OBC Reference _____

COMPLIANCE ALTERNATIVES C89, C90, C92 TO C94, C176 & C191

Compliance alternatives are categorized into separate tables according to their application to a specific occupancy. For example **C94** is the ninety-fourth *compliance alternative* for "**C**" or **Residential Occupancies**. Since this course primarily deals with *residential occupancies* all of the *compliance alternatives* examined in this course are from Table 11.5.1.1.C.

Selecting C94 as an example for *compliance alternative*; reference Division B, Subsection **6.3.1. General**, of **Section 6.3 Chimneys and Venting Equipment**. The Part 6 requirement is as follows:

- - - - - - - - - - - - - - - - - *start of OBC text* - - - - - - - - - - - - - - - - -

Section 6.3. Chimneys and Venting Equipment

6.3.1. General

6.3.1.1. Requirement for Venting

(1) Except as provided in Articles 6.3.1.2. and 6.3.1.3., the products of combustion from solid fuel-burning *appliances* shall be vented in conformance with the requirements in the applicable *appliance* installation standards listed in Article 6.2.1.4.

6.3.1.2. Masonry or Concrete Chimneys

(1) Rectangular *masonry or concrete chimneys* not more than 12 m in height shall conform to Part 9 if they serve,

a) *appliances* with a combined total rated heat output of 120 kW or less, or

b) fireplaces.

(2) *Masonry or concrete chimneys* other than those described in Sentence (1) shall be designed and installed in conformance with the appropriate requirements in NFPA 211, "Standard for Chimneys, Fireplaces, Vents and Solid Fuel-Burning Appliances".

6.3.1.3. Metal Smoke Stacks

(1) Single wall metal smoke stacks shall be designed and installed in conformance with NFPA 211, "Standard for Chimneys, Fireplaces, Vents and Solid Fuel-Burning Appliances".

6.3.1.4. Reserved

6.3.1.5. Access Ladders

(1) Access ladders for *chimneys*, when provided, shall consist of steel or bronze rungs, built into the walls of the *chimneys*.

(2) Rungs for external ladders shall begin at not less than 2 500 mm from ground level.

- - - - - - - - - - - - - - - - - *end of OBC text* - - - - - - - - - - - - - - -

Subsection 6.3.1. sets out the OBC requirements for chimneys and venting equipment. In the case of an existing *building* with proposed alterations to *building systems* the *compliance alternative* C94 reduces the Part 6 requirement as worded.

- - - - - - - - - - - - - - - - - *start of OBC text* - - - - - - - - - - - - - - -

C94 – Existing acceptable, provided products of combustion are safely vented.

- - - - - - - - - - - - - - - - - *end of OBC text* - - - - - - - - - - - - - - -

This *compliance alternative* takes into account the functionality of the existing venting equipment and sets a safe operation requirement.

The following portion of Table 11.5.1.1.C. contains some of the *compliance alternatives* directly related to the scope of the HVAC – House course.

Table 11.5.1.1.C.
Compliance Alternatives for Residential Occupancies
Forming Part of Article 11.5.1.1.

TABLE 8-1

NUMBER	PART 6 REQUIREMENT	PART 11 COMPLIANCE ALTERNATIVE
C89	6.2.4.2.(1); 6.2.4.3.(1) to (3) and (5)	Existing acceptable.
C90	6.2.4.3.(10)	Where the duct system is being altered, lesser amounts and extent of insulation will be permitted.
C92	6.2.9.2.	Existing acceptable.
C93	6.2.12.3.(1)	Carbon monoxide detectors may be battery operated or plugged into an electrical outlet.
C94	6.3.1.	Existing acceptable, provided products of combustion are safely vented.
NUMBER	PART 9 REQUIREMENT	PART 11 COMPLIANCE ALTERNATIVE
C176	9.18.3.	Existing vents and ventilation acceptable.
C191	9.32.	In detached houses, semi-detached houses, townhouses and row houses containing not more than two *dwelling units*, rooms or spaces in *dwelling units* to be ventilated by natural means in accordance with Subsection 9.32.2. or by providing adequate mechanical ventilation.

EXERCISE #8-2

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple choice method.

1. The OBC text for 6.2.4.3.(10) reads as follows:

   (10) Where a *supply* or *return duct* is not protected by an insulated exterior wall or where the duct is exposed to an unheated space it shall be insulated to provide a thermal resistance of not less than RSI 2.1.

   Compliance Alternative C90 in Table 11.5.1.1.C. lists the following alternative:

   Where the duct system is being altered, lesser amounts and extent of insulation will be permitted.

   Which one of the following best describes the intent of the *compliance alternative*?

   a) solution of a structural problem;
   b) preservation of a *heritage building;*
   c) increase in *performance level;*
   d) solution for an altered *building system.*

OBC Reference _____

2. The OBC text for 9.32.1.1.(1) forming part of the requirements of Section 9.32., reads as follows:

   (1) This Section applies to the ventilation of rooms and spaces in *residential occupancies* by natural ventilation and to self-contained mechanical ventilation systems serving only one *dwelling unit*.

   Compliance Alternative C191 in Table 11.5.1.1.C. lists the following alternative:

   In detached houses, semi-detached houses, townhouses and row houses containing not more than two *dwelling units*, rooms or spaces in *dwelling units* to be ventilated by natural means in accordance with Subsection 9.32.2. or by providing adequate mechanical ventilation.

   Which one of the following best describes the intent of the *compliance alternative*?

   a) Relaxing of natural ventilation requirement to include *buildings* with up to two *dwelling units;*
   b) Solution to a structural problem;
   c) Promote splitting of house into *suites;*
   d) Relaxing of mechanical ventilation requirement to include *buildings* with up to two *dwelling units.*

OBC Reference _____

COMPLIANCE ALTERNATIVES C192, C193, C194

Selecting C192 as an example for *compliance alternative;* reference **Article 9.33.1.1. Design and Installation Requirements**, of **Section 9.33 Heating and Air-Conditioning**. The Part 9 requirement is as follows:

- - - - - - - - - - - - - - - - *start of OBC text* - - - - - - - - - - - - - - - -

9.33.1.1. Design and Installation Requirements

(1) The design and installation of central heating systems including requirements for combustion air, shall conform to the requirements in Part 6 and to this Section.

(2) The design and installation of *air-conditioning* systems shall conform to Part 6.

(3) Repairs, adjustments or component replacements that change the capacity or extent of safety of an existing heating, ventilating or *air-conditioning* system and that alter the method of operation shall conform to this Code.

- - - - - - - - - - - - - - - - - *end of OBC text* - - - - - - - - - - - - - - - -

Article 9.33.1.1. sets out the OBC requirements for design and installation and describes the applicable Parts for conformance. In the case of an existing *building* with proposed alterations to *building systems* the *compliance alternative* C192 revises the Part 9 requirement as worded

- - - - - - - - - - - - - - - - - *start of OBC text* - - - - - - - - - - - - - - - -

C192 In a *building* containing not more than four *dwelling units*, the existing heating or *air conditioning* system may be altered to serve more than one *dwelling unit* provided *smoke alarms* are installed in each *dwelling unit* and provided *a smoke detector is* installed in the supply or return air duct system serving the entire *building* which would turn off the fuel supply and electrical power to the heating system upon activation of such detectors.

- - - - - - - - - - - - - - - - - *end of OBC text* - - - - - - - - - - - - - - - -

This *compliance alternative* takes into account the likely situation that for an older multi-*dwelling unit* building a single heating or air-conditioning system serves all the suites. The *compliance alternative* recognizes the impractical requirement for individual self-contained *dwelling unit* heating or air-conditioning systems and sets out a technical means to provide smoke detection and automatic shut-down of the heating or air-conditioning system upon the activation of the detectors. A likely system arrangement for the *dwelling units* is shown in the sketch below.

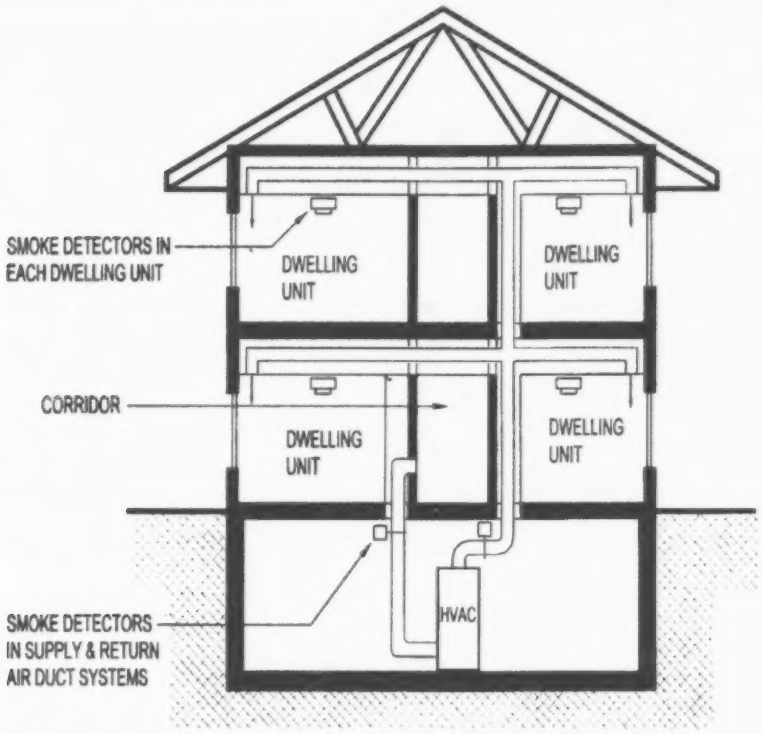


FIGURE 8-1

The following portion of Table 11.5.1.1.C. contains the balance of the *compliance alternatives* directly related to the scope of the HVAC – House course.

Table 11.5.1.1.C.
Compliance Alternatives for Residential Occupancies
Forming Part of Article 11.5.1.1.

TABLE 8-2

NUMBER	PART 9 REQUIREMENT	PART 11 COMPLIANCE ALTERNATIVE
C192	9.33.1.1.	In a *building* containing not more than four *dwelling units*, the existing heating or *air conditioning* system may be altered to serve more than one *dwelling unit* provided *smoke alarms* are installed in each *dwelling unit* and provided a *smoke detector* is installed in the supply or return air duct system serving the entire *building* which would turn off the fuel supply and electrical power to the heating system upon activation of such detectors.
C193	9.33.1.2.	Sound, used or antique *appliances* are acceptable, provided that: (a) visual examination shows no excessive weakening by corrosion or other damage, (b) no structural parts are missing, (c) no cracks are present in the components intended to support the *appliance* or enclose the fire, and (d) loading and ash removal door latches and hinges hold the door closed.
C194	9.33.4.3.(1)	Carbon monoxide detectors may be battery operated or plugged into an electrical outlet.

EXERCISE #8-3

For each of the following questions review the presented text and use the applicable OBC references to select the correct answer using the multiple choice method.

1. The OBC text for 9.33.1.2. forming part of the requirements of Section 9.33., reads as follows:

   9.33.1.2. Solid Fuel-Burning Appliances

   (1) The design, construction and installation, including the provision of combustible air, of solid-fuel burning appliances and equipment, including *stoves*, *ranges* and *space heaters*, shall conform to CAN/CSA-B365-M, "Installation Code for Solid-Fuel Burning Appliances and Equipment"

   Compliance Alternative C193 in Table 11.5.1.1.C. lists the following alternative:

   Sound, used or antique *appliances* are acceptable, provided that:

   (a) visual examination shows no excessive weakening by corrosion or other damage,
   (b) no structural parts are missing,
   (c) no cracks are present in the components intended to support the *appliance* or enclose the fire, and
   (d) loading and ash removal door latches and hinges hold the door closed.

   Which one of the following best describes the intent of the *compliance alternative*?

   a) solution to removal of heavy cast iron equipment;
   b) preservation of heritage or antique equipment;
   c) conformance and safety based on actual condition of existing equipment;
   d) solution to structural problem.

OBC Reference _____

2. The OBC text for 9.33.4.3.(1) forming part of the requirements of Section 9.33., reads as follows:

(1) The carbon monoxide detector required by Article 9.33.4.2. shall,

(a) be permanently connected to an electrical circuit and shall have no disconnect switch between the overcurrent device and the carbon monoxide detector,

(b) be wired so that its activation will activate all carbon monoxide detectors within the *suite*, where located within a *suite* of *residential occupancy*,

(c) be equipped with an alarm that is audible within bedrooms when the intervening doors are closed, where located adjacent to a sleeping area, and

(d) conform to

(i) CAN/CGA-6.19, "Residential Carbon Monoxide Alarming Devices",

(ii) UL 2034, "Single and Multiple Station Carbon Monoxide Alarms"

Compliance Alternative C194in Table 11.5.1.1.C. lists the following alternative:

Carbon monoxide detectors may be battery operated or plugged into an electrical outlet.

Which one of the following best describes the intent of the *compliance alternative*?

a) solution to structural problem;
b) solution for safe/practical addition of *building system;* (no new electrical circuits required)
c) limit electrical loads for existing *building;*
d) provide immediate detector coverage.

OBC Reference _____

HVAC – HOUSE
ANSWER GUIDE

Module 1: Answers to Multiple Choice Questions

Module # 1	Exercise # 1-1	Sample Question	n/a
Module # 1	Exercise # 1-1	Question # 1	Correct Answer: b
Module # 1	Exercise # 1-1	Question # 2	Correct Answer: b
Module # 1	Exercise # 1-1	Question # 3	Correct Answer: d
Module # 1	Exercise # 1-1	Question # 4	Correct Answer: a
Module # 1	Exercise # 1-2	Sample Question	n/a
Module # 1	Exercise # 1-2	Question # 1	Correct Answer: b
Module # 1	Exercise # 1-2	Question # 2	Correct Answer: d
Module # 1	Exercise # 1-2	Question # 3	Correct Answer: a
Module # 1	Exercise # 1-2	Question # 4	Correct Answer: c
Module # 1	Exercise # 1-3	Sample Question	Correct Answer: c
Module # 1	Exercise # 1-3	Question # 1	Correct Answer: c
Module # 1	Exercise # 1-3	Question # 2	Correct Answer: c
Module # 1	Exercise # 1-3	Question # 3	Correct Answer: d

Module 2: Answers to Multiple Choice Questions

Module # 2	Exercise # 2-1	Sample Question	Correct Answer: a
Module # 2	Exercise # 2-1	Question # 1	Correct Answer: a
Module # 2	Exercise # 2-1	Question # 2	Correct Answer: c
Module # 2	Exercise # 2-1	Question # 3	Correct Answer: b
Module # 2	Exercise # 2-2	Sample Question	Correct Answer: c
Module # 2	Exercise # 2-2	Question # 1	Correct Answer: c
Module # 2	Exercise # 2-2	Question # 2	Correct Answer: b
Module # 2	Exercise # 2-2	Question # 3	Correct Answer: a
Module # 2	Exercise # 2-2	Question # 4	Correct Answer: b
Module # 2	Exercise # 2-3	Sample Question	Correct Answer: c
Module # 2	Exercise # 2-3	Question # 1	Correct Answer: b
Module # 2	Exercise # 2-3	Question # 2	Correct Answer: c
Module # 2	Exercise # 2-3	Question # 3	Correct Answer: a
Module # 2	Exercise # 2-4	Sample Question	Correct Answer: c
Module # 2	Exercise # 2-4	Question # 1	Correct Answer: d
Module # 2	Exercise # 2-4	Question # 2	Correct Answer: b

Module 3: Answers to Multiple Choice Questions

Module # 3	Exercise # 3-1	Sample Question	Correct Answer: b
Module # 3	Exercise # 3-1	Question # 1	Correct Answer: c
Module # 3	Exercise # 3-1	Question # 2	Correct Answer: a
Module # 3	Exercise # 3-1	Question # 3	Correct Answer: d
Module # 3	Exercise # 3-1	Question # 4	Correct Answer: c
Module # 3	Exercise # 3-2	Sample Question	Correct Answer: d
Module # 3	Exercise # 3-2	Question # 1	Correct Answer: d
Module # 3	Exercise # 3-2	Question # 2	Correct Answer: c
Module # 3	Exercise # 3-2	Question # 3	Correct Answer: b
Module # 3	Exercise # 3-2	Question # 4	Correct Answer: c
Module # 3	Exercise # 3-3	Sample Question	Correct Answer: d
Module # 3	Exercise # 3-3	Question # 1	Correct Answer: c
Module # 3	Exercise # 3-3	Question # 2	Correct Answer: d
Module # 3	Exercise # 3-3	Question # 3	Correct Answer: a
Module # 3	Exercise # 3-3	Question # 4	Correct Answer: d
Module # 3	Exercise # 3-4	Sample Question	Correct Answer: b
Module # 3	Exercise # 3-4	Question # 1	Correct Answer: c
Module # 3	Exercise # 3-4	Question # 2	Correct Answer: b
Module # 3	Exercise # 3-4	Question # 3	Correct Answer: c
Module # 3	Exercise # 3-4	Question # 4	Correct Answer: c
Module # 3	Exercise # 3-4	Question # 5	Correct Answer: a

Module 4: Answers to Multiple Choice Questions

Module # 4	Exercise #4-1	Example Question	Correct Answer: b
Module # 4	Exercise #4-1	Question # 1	Correct Answer: c
Module # 4	Exercise #4-1	Question # 2	Correct Answer: b
Module # 4	Exercise #4-1	Question # 3	Correct Answer: c
Module # 4	Exercise #4-1	Question # 4	Correct Answer: a
Module # 4	Exercise #4-2	Example Question	Correct Answer: b and c
Module # 4	Exercise #4-2	Question # 1	Correct Answer: b
Module # 4	Exercise #4-2	Question # 2	Correct Answer: b
Module # 4	Exercise #4-2	Question # 3	Correct Answer: d
Module # 4	Exercise #4-2	Question # 4	Correct Answer: c

Module 5: Answers to Multiple Choice Questions

Module # 5	Exercise # 5-1	Sample Question	Correct Answer: b
Module # 5	Exercise # 5-1	Question # 1	Correct Answer: b
Module # 5	Exercise # 5-1	Question # 2	Correct Answer: d
Module # 5	Exercise # 5-1	Question # 3	Correct Answer: b
Module # 5	Exercise # 5-1	Question # 4	Correct Answer: d
Module # 5	Exercise # 5-1	Question # 5	Correct Answer: c
Module # 5	Exercise # 5-2	Sample Question	Correct Answer: c
Module # 5	Exercise # 5-2	Question # 1	Correct Answer: a
Module # 5	Exercise # 5-2	Question # 2	Correct Answer: d
Module # 5	Exercise # 5-2	Question # 3	Correct Answer: b
Module # 5	Exercise # 5-2	Question # 4	Correct Answer: b
Module # 5	Exercise # 5-3	Sample Question	Correct Answer: c
Module # 5	Exercise # 5-3	Question # 1	Correct Answer: c
Module # 5	Exercise # 5-3	Question # 2	Correct Answer: c
Module # 5	Exercise # 5-3	Question # 3	Correct Answer: a
Module # 5	Exercise # 5-3	Question # 4	Correct Answer: d
Module # 5	Exercise # 5-4	Sample Question	Correct Answer: d
Module # 5	Exercise # 5-4	Question # 1	Correct Answer: b
Module # 5	Exercise # 5-4	Question # 2	Correct Answer: a
Module # 5	Exercise # 5-4	Question # 3	Correct Answer: a
Module # 5	Exercise # 5-4	Question # 4	Correct Answer: d

Module 6: Answers to Multiple Choice Questions

Module # 6	Exercise # 6-1	Sample Question	Correct Answer: c
Module # 6	Exercise # 6-1	Question # 1	Correct Answer: a
Module # 6	Exercise # 6-1	Question # 2	Correct Answer: c
Module # 6	Exercise # 6-1	Question # 3	Correct Answer: d
Module # 6	Exercise # 6-1	Question # 4	Correct Answer: b
Module # 6	Exercise # 6-2	Sample Question	Correct Answer: d
Module # 6	Exercise # 6-2	Question # 1	Correct Answer: d
Module # 6	Exercise # 6-2	Question # 2	Correct Answer: b
Module # 6	Exercise # 6-2	Question # 3	Correct Answer: b
Module # 6	Exercise # 6-2	Question # 4	Correct Answer: b
Module # 6	Exercise # 6-3	Sample Question	Correct Answer: c
Module # 6	Exercise # 6-3	Question # 1	Correct Answer: b

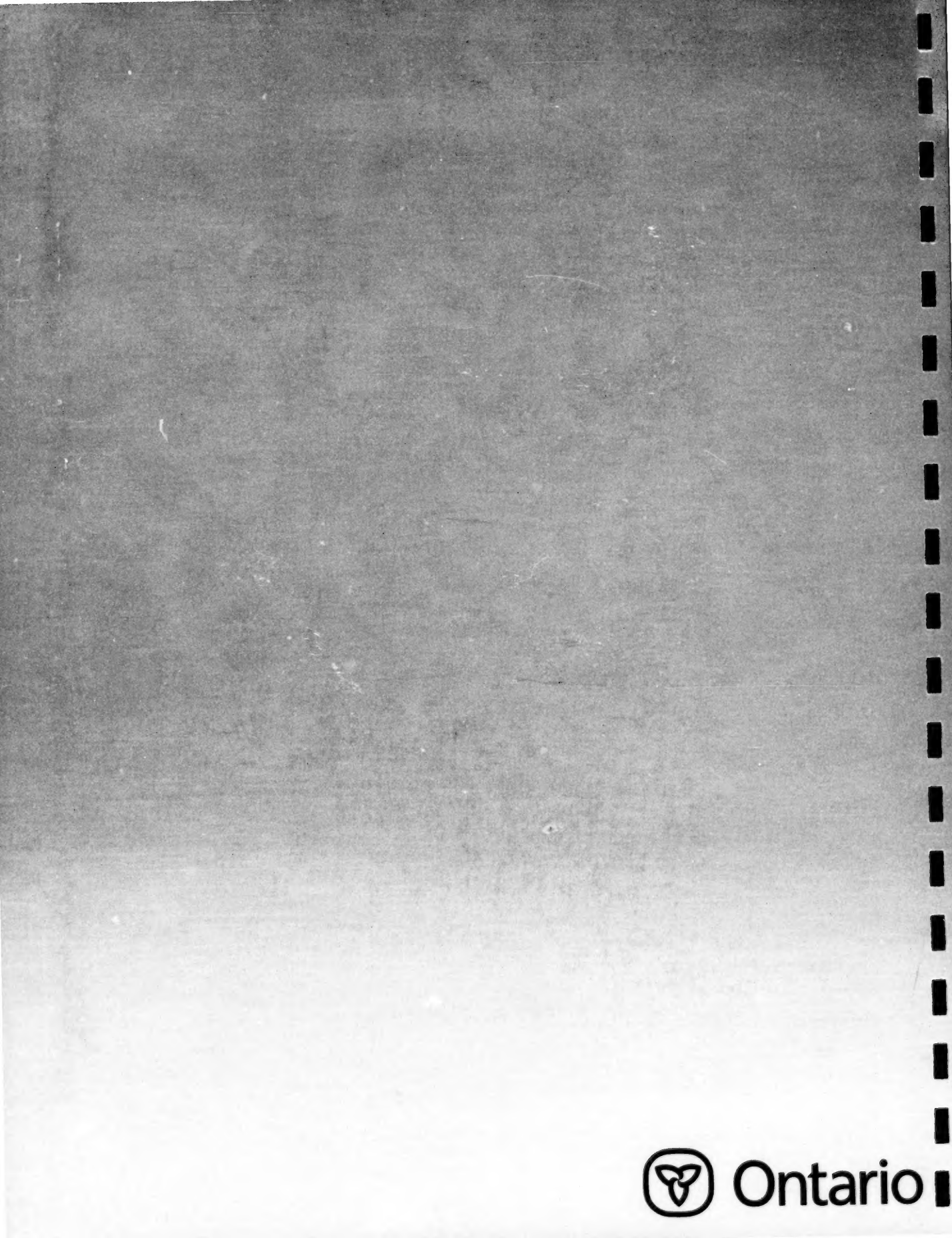
Module # 6	Exercise # 6-3	Question # 2	Correct Answer: d
Module # 6	Exercise # 6-3	Question # 3	Correct Answer: b
Module # 6	Exercise # 6-3	Question # 4	Correct Answer: c
Module # 6	Exercise # 6-4	Sample Question	Correct Answer: b
Module # 6	Exercise # 6-4	Question # 1	Correct Answer: c
Module # 6	Exercise # 6-4	Question # 2	Correct Answer: d
Module # 6	Exercise # 6-4	Question # 3	Correct Answer: c
Module # 6	Exercise # 6-4	Question # 4	Correct Answer: a
Module # 6	Exercise # 6-5	Sample Question	Correct Answer: d
Module # 6	Exercise # 6-5	Question # 1	Correct Answer: b
Module # 6	Exercise # 6-5	Question # 2	Correct Answer: b
Module # 6	Exercise # 6-5	Question # 3	Correct Answer: a
Module # 6	Exercise # 6-5	Question # 4	Correct Answer: c
Module # 6	Exercise # 6-6	Sample Question	Correct Answer: c
Module # 6	Exercise # 6-6	Question # 1	Correct Answer: c
Module # 6	Exercise # 6-6	Question # 2	Correct Answer: c
Module # 6	Exercise # 6-6	Question # 3	Correct Answer: a
Module # 6	Exercise # 6-6	Question # 4	Correct Answer: c
Module # 6	Exercise # 6-7	Sample Question	Correct Answer: d
Module # 6	Exercise # 6-7	Question # 1	Correct Answer: d
Module # 6	Exercise # 6-7	Question # 2	Correct Answer: c
Module # 6	Exercise # 6-7	Question # 3	Correct Answer: c
Module # 6	Exercise # 6-7	Question # 4	Correct Answer: b

Module 7: Answers to Multiple Choice Questions

Module # 7	Exercise # 7-1	Sample Question	Correct Answer: b
Module # 7	Exercise # 7-1	Question # 1	Correct Answer: d
Module # 7	Exercise # 7-1	Question # 2	Correct Answer: a
Module # 7	Exercise # 7-1	Question # 3	Correct Answer: b
Module # 7	Exercise # 7-1	Question # 4	Correct Answer: a
Module # 7	Exercise # 7-1	Question # 5	Correct Answer: c
Module # 7	Exercise # 7-2	Sample Question	Correct Answer: d
Module # 7	Exercise # 7-2	Question # 1	Correct Answer: c
Module # 7	Exercise # 7-2	Question # 2	Correct Answer: c
Module # 7	Exercise # 7-2	Question # 3	Correct Answer: b
Module # 7	Exercise # 7-2	Question # 4	Correct Answer: d

Module 8: Answers to Multiple Choice Questions

Module # 8	Exercise # 8-1	Sample Question	Correct Answer: c
Module # 8	Exercise # 8-1	Question # 1	Correct Answer: a
Module # 8	Exercise # 8-1	Question # 2	Correct Answer: c
Module # 8	Exercise # 8-1	Question # 3	Correct Answer: d
Module # 8	Exercise # 8-1	Question # 4	Correct Answer: a
Module # 8	Exercise # 8-2	Question # 1	Correct Answer: d
Module # 8	Exercise # 8-2	Question # 2	Correct Answer: d
Module # 8	Exercise # 8-3	Question # 1	Correct Answer: c
Module # 8	Exercise # 8-3	Question # 2	Correct Answer: b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